

**А.Ю. РОЗАНОВ**

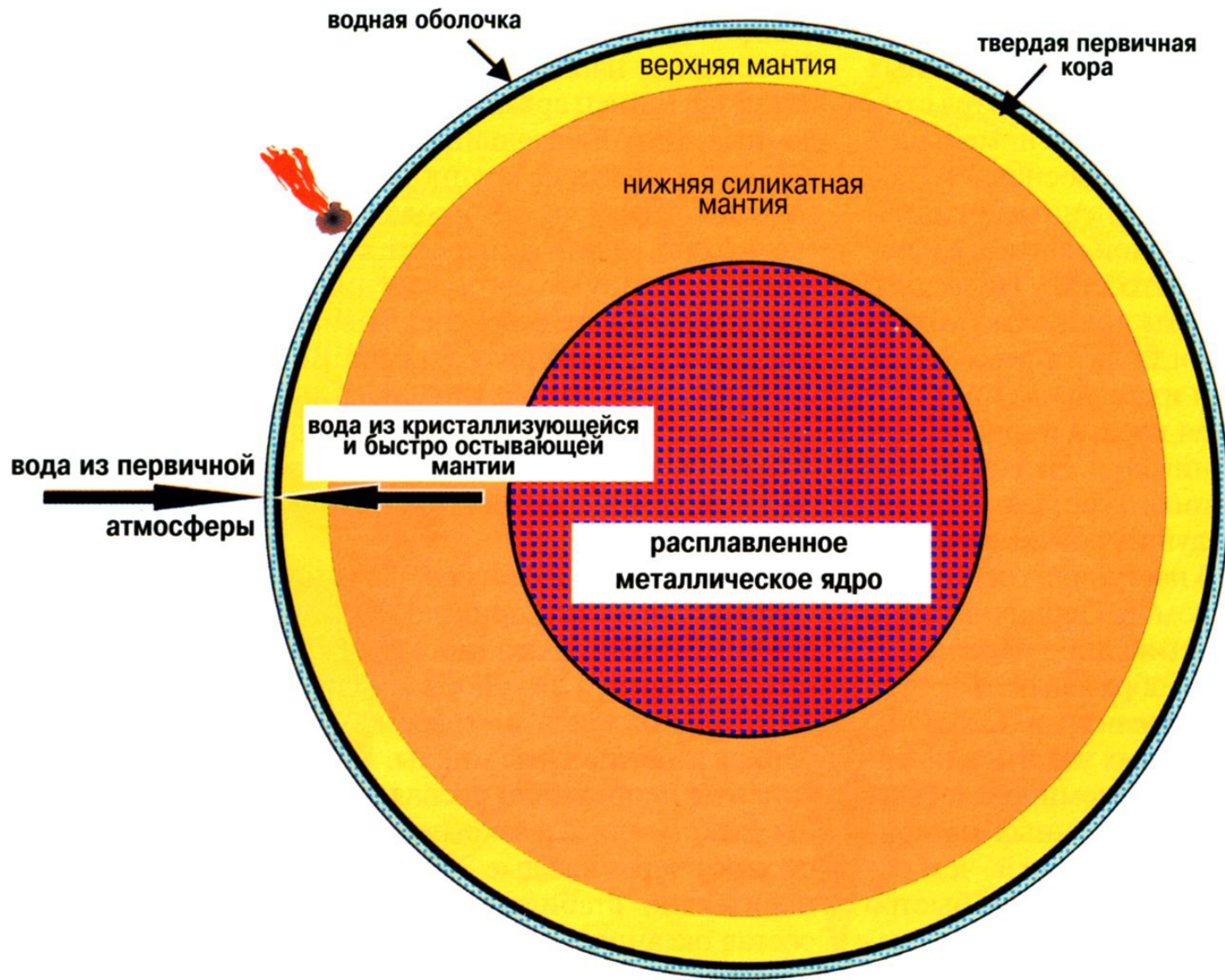
Палеонтологический институт РАН

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**ГАИШ**

**2016**

**1**



*Предполагаемый  
разрез Земли  
около 4,3 млрд лет назад  
и схема образования  
первичного водного океана.  
(Никишин, 2012)*

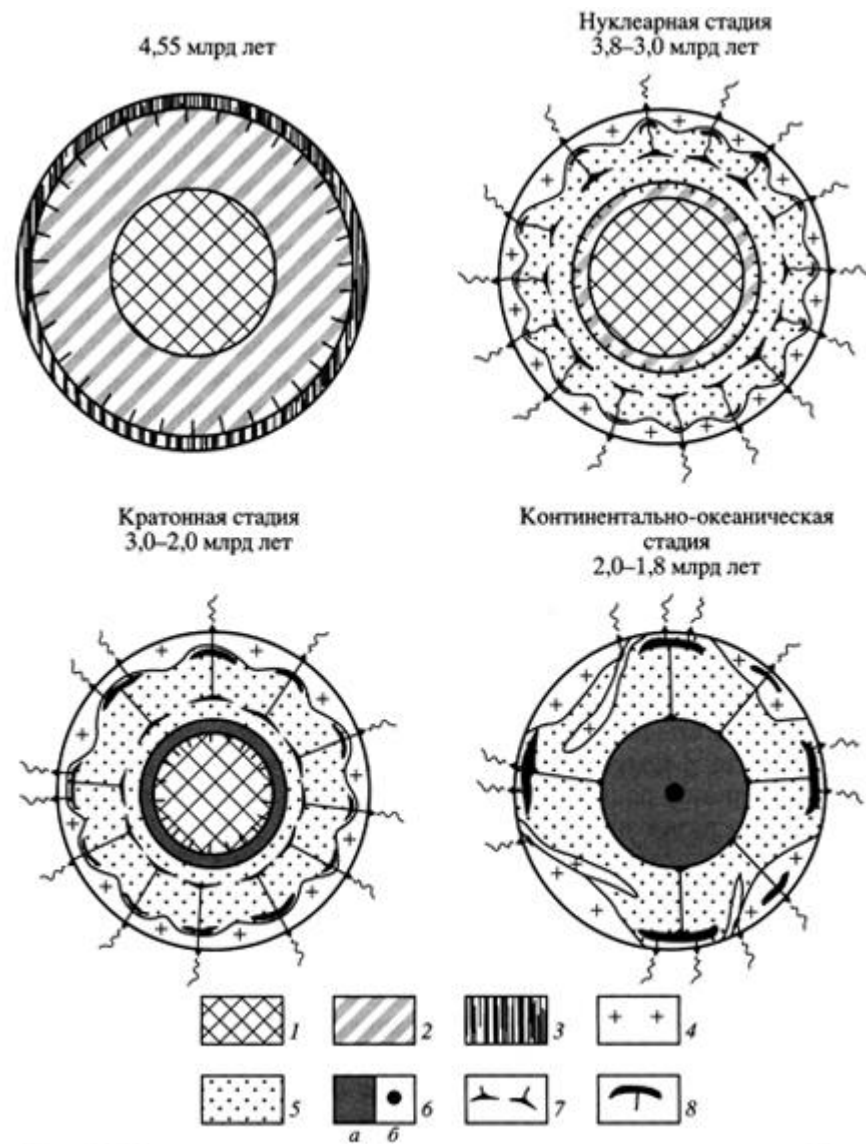
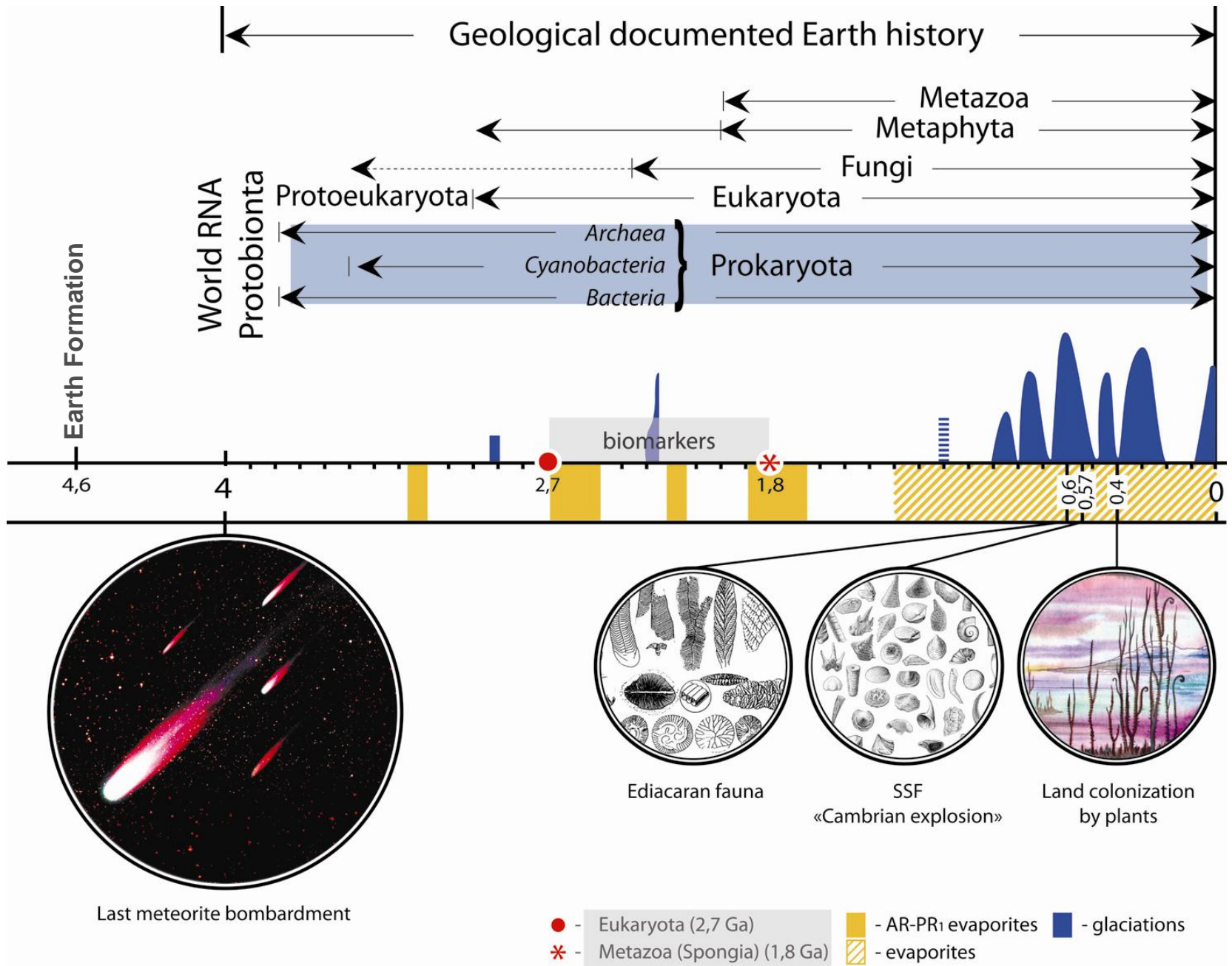
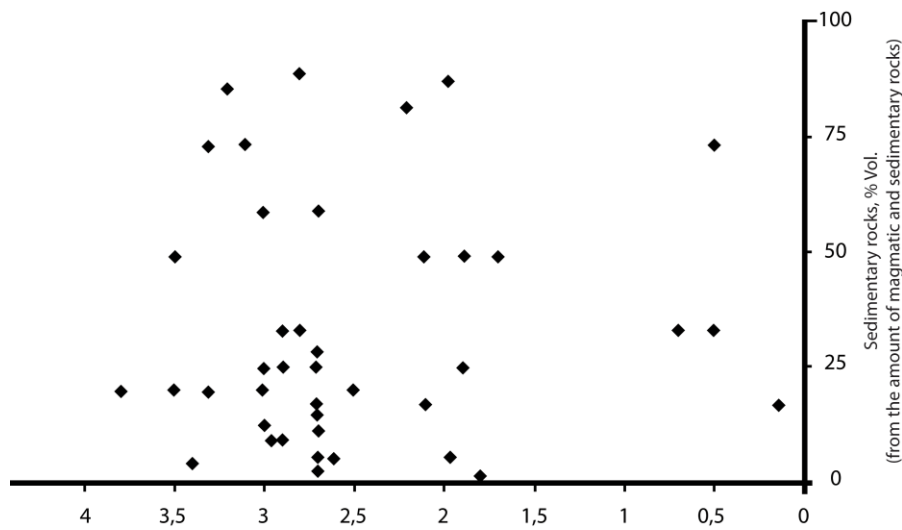
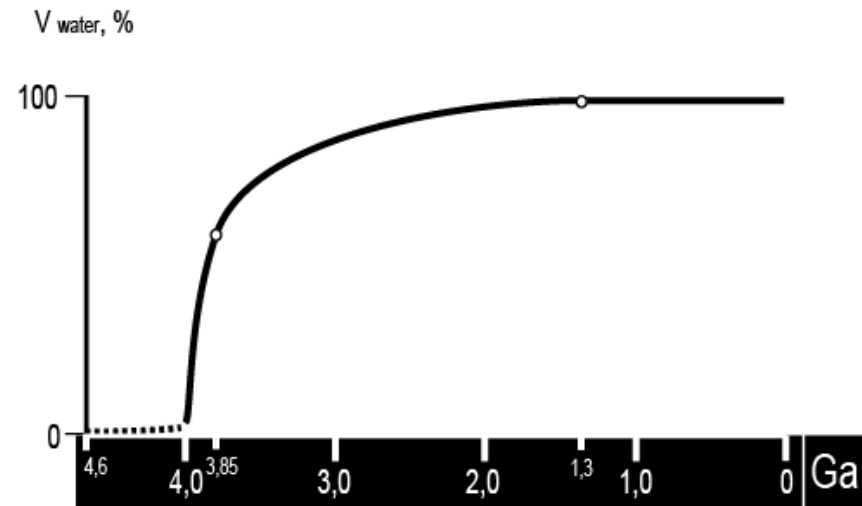


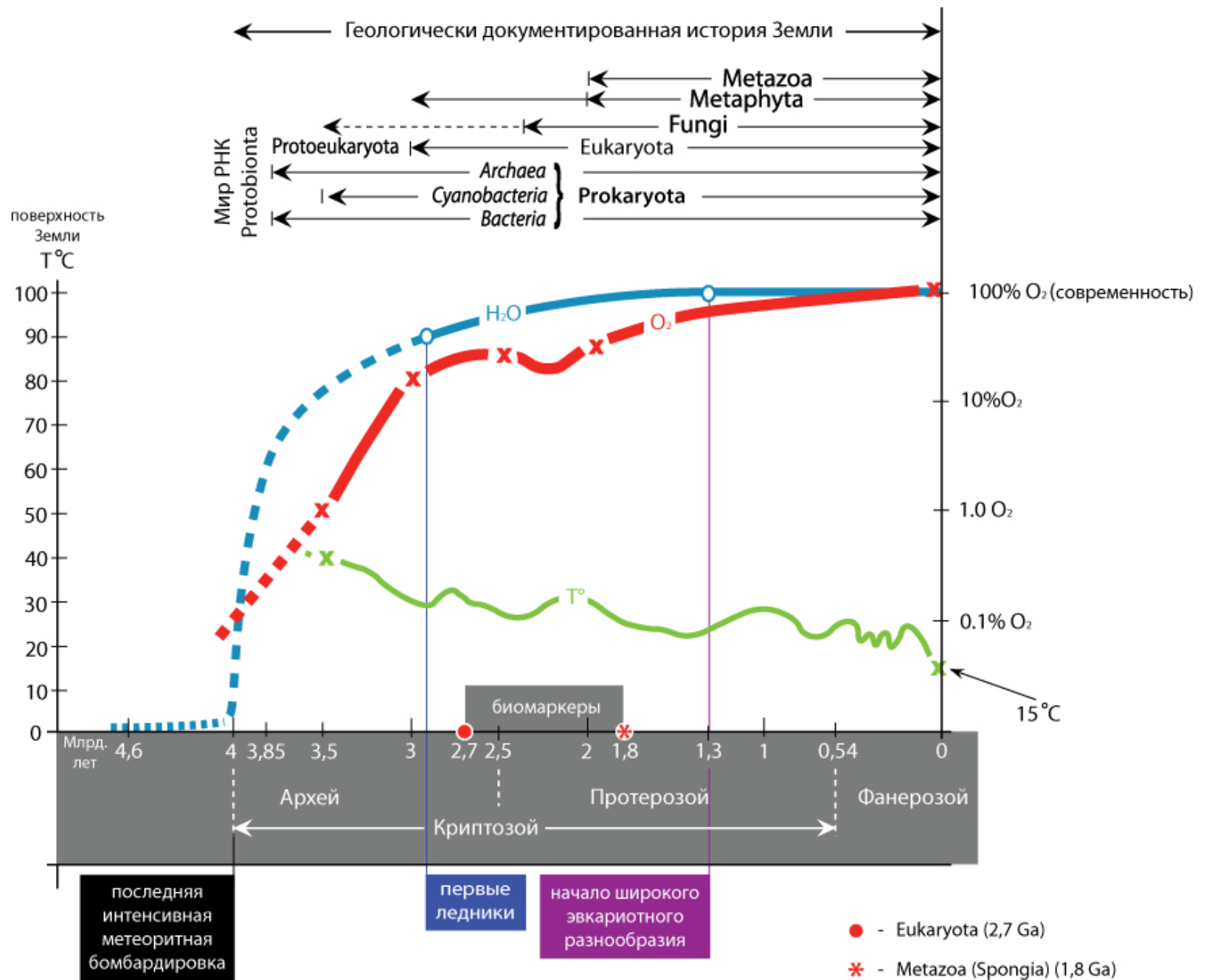
Рис. 9-23. Схема, иллюстрирующая главные этапы внутреннего развития Земли  
 1 – первичное ядро; 2 – первичная мантия; 3 – магматический океан; 4 – сиалическая кора; 5 – деплетир-  
 ванная мантия; 6 – ядро: а – жидкое, б – твердое; 7 – фронт разогрева; 8 – мантийные плюмы

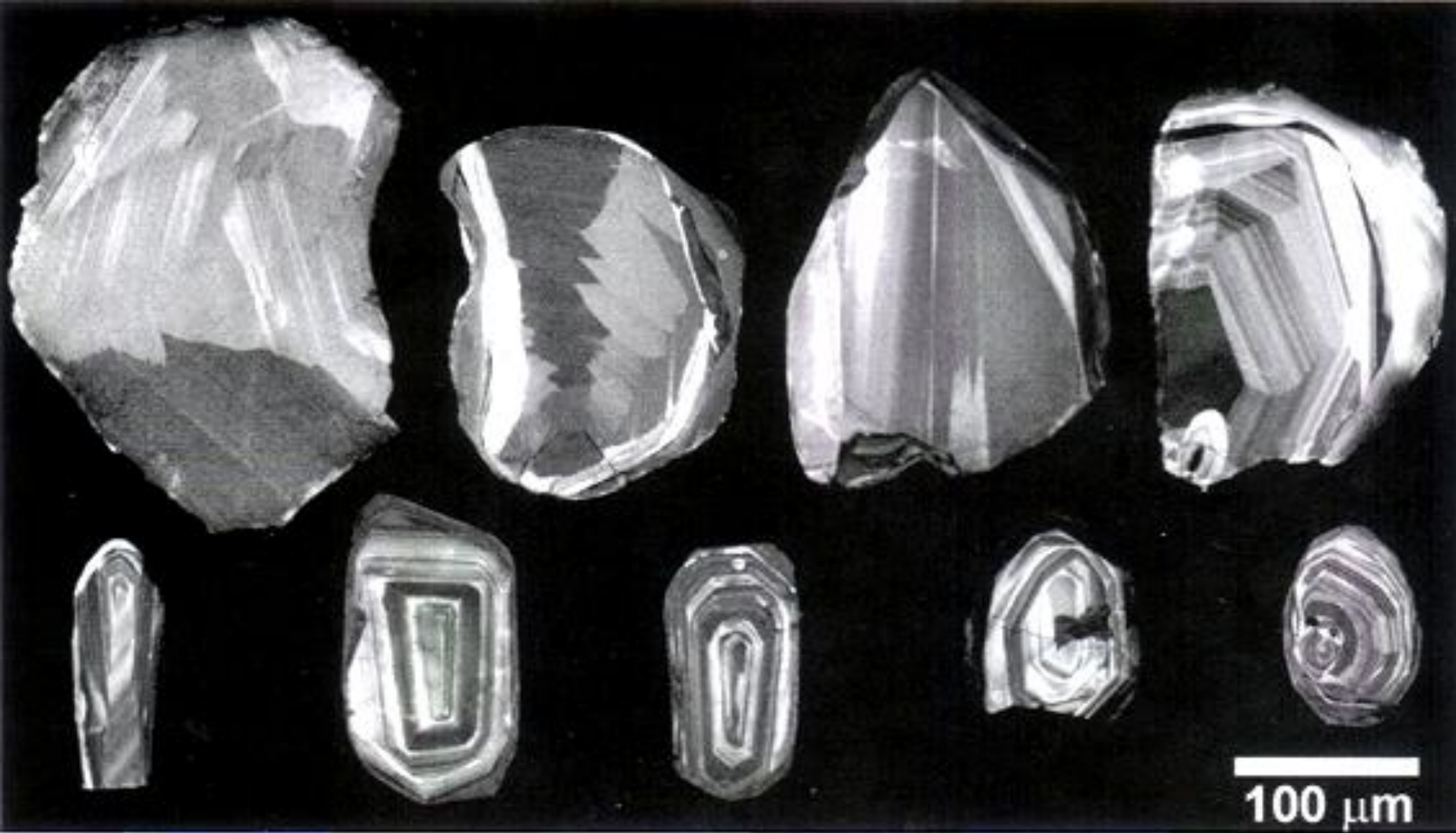




The sedimentary rocks part of total amount of rocks (abyssal and sedimentary) in the sequences of greenstone belts (for 44 belts, according to the data of DeWit, Ashal, 1997)







*Ancient zircon crystal from rocks  
(more than 4 billion years old) Western, Australia  
(Crowley et al., 2005).*

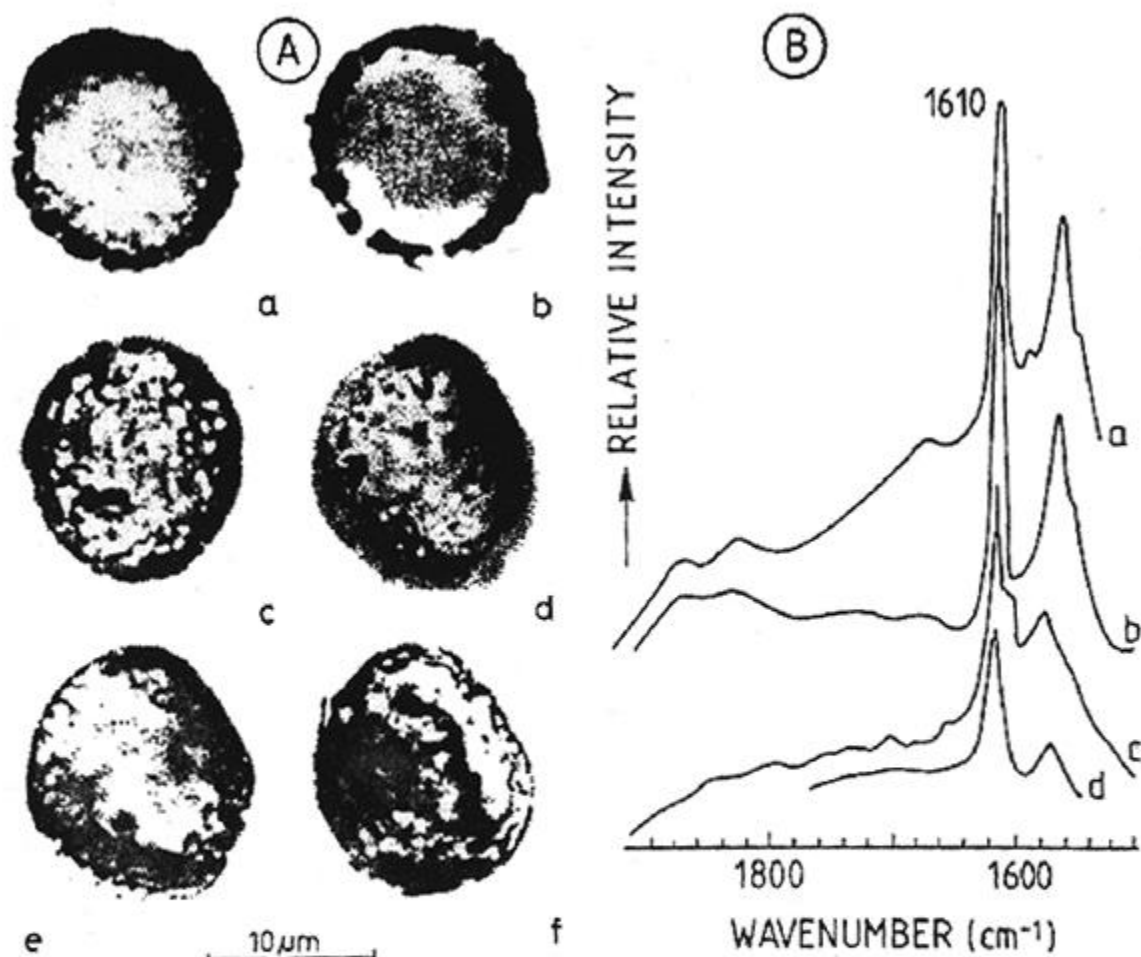
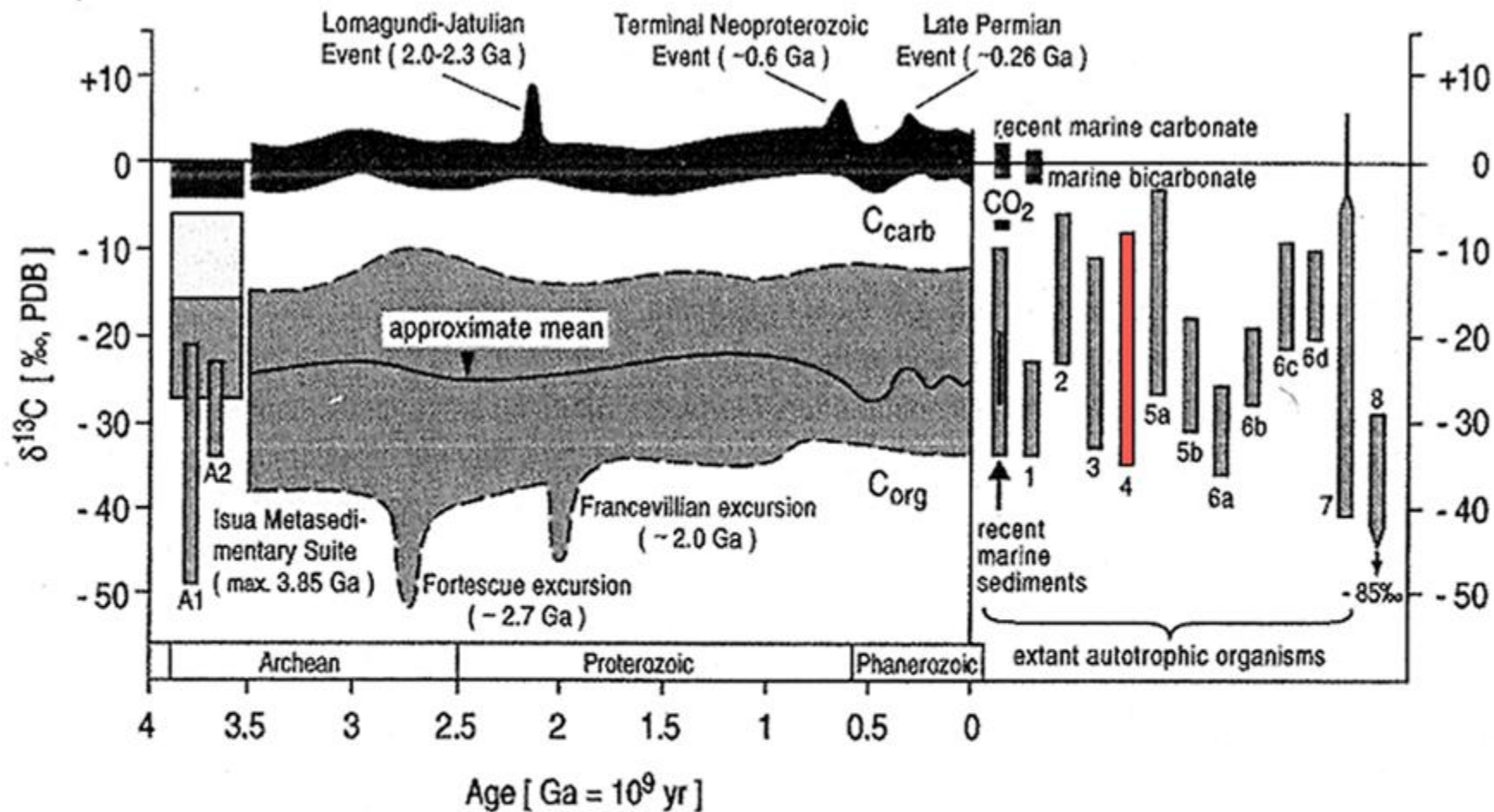
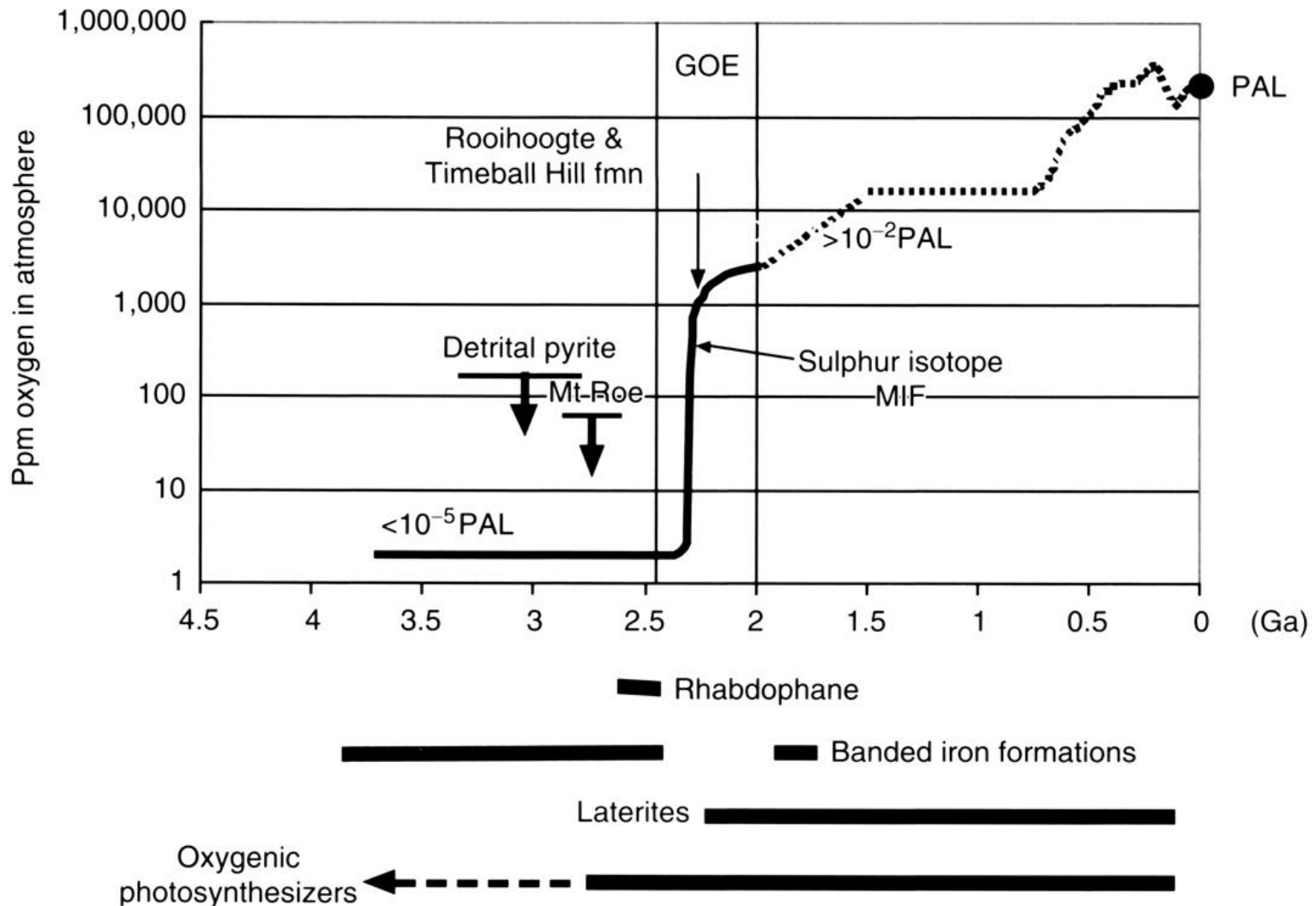


Fig. 23.3 A: Comparison of *Huroniospora* sp. from the ~2.0 Ga-old Gunflint iron formation, Ontario (a-c) with *Isuasphaera* sp. from the ~3.8 Ga-old Isua metasedimentary suite, West Greenland (d-f). The optically distinctive marginal rim may be explained as a relic of the original cell wall. B: Laser Raman spectra obtained from *Huroniospora* sp. as an isolated particle (a) and in thin sections (b) compared to those from *Isuasphaera* sp. (c, d) obtained under the same conditions. The close resemblance of the spectra suggests similarities in the composition of the residual organic component of the two types of microstructures. The prominent peak close to 1610 cm<sup>-1</sup> is indicative of aromatic double bonds among the carbon atoms of the molecular structure (adapted from [44]).

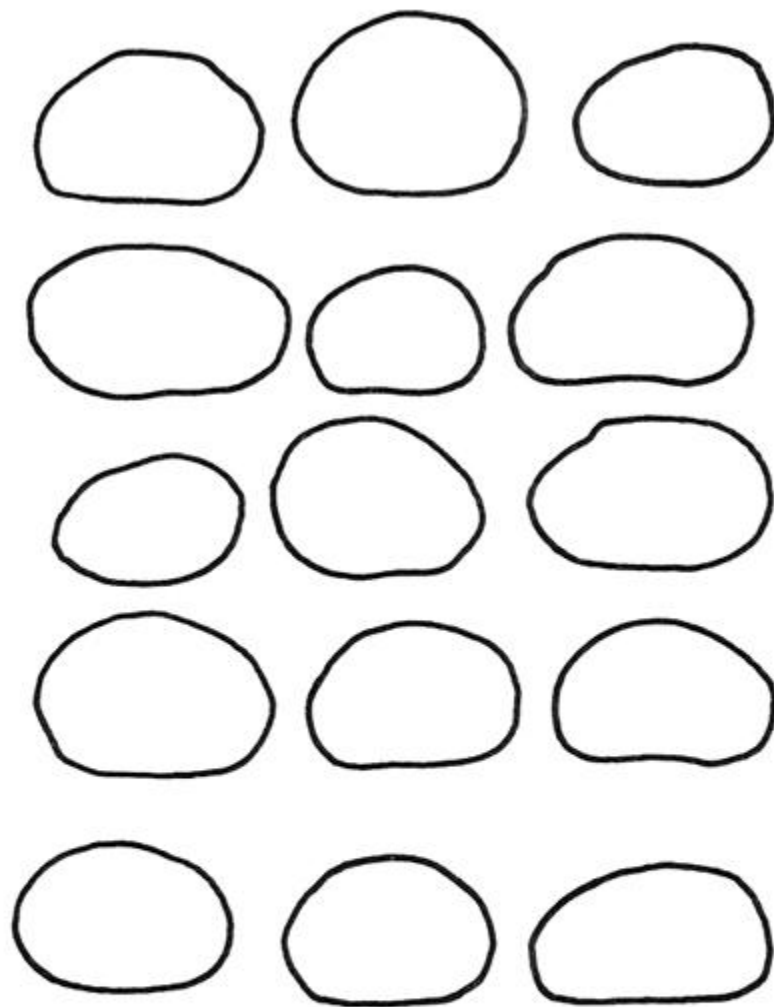
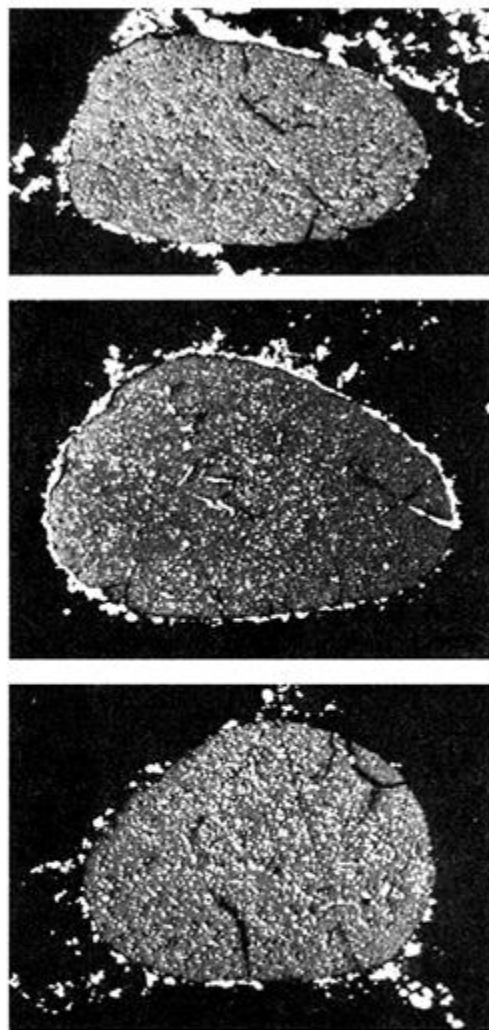


Isotope age functions of organic carbon ( $C_{org}$ ) and carbonate carbon ( $C_{carb}$ ) as compared with the isotopic compositions of their progenitor substances in the present environment (marine bicarbonate and biogenic matter of various parentage, cf. Right box).

Contributors to the contemporary biomass are (1) C3 plants, (2) C4 plants, (3) CAM plants, (4) eukaryotic algae, (5a,b) natural and cultured cyanobacteria, (6) groups of photosynthetic bacteria other than cyanobacteria, (7) methanogenic bacteria, (8) methanotrophic bacteria. The  $\delta^{13}C_{org}$  range in recent marine sediments [45] is based on some 1600 data points (black insert covers >90% of the data base).



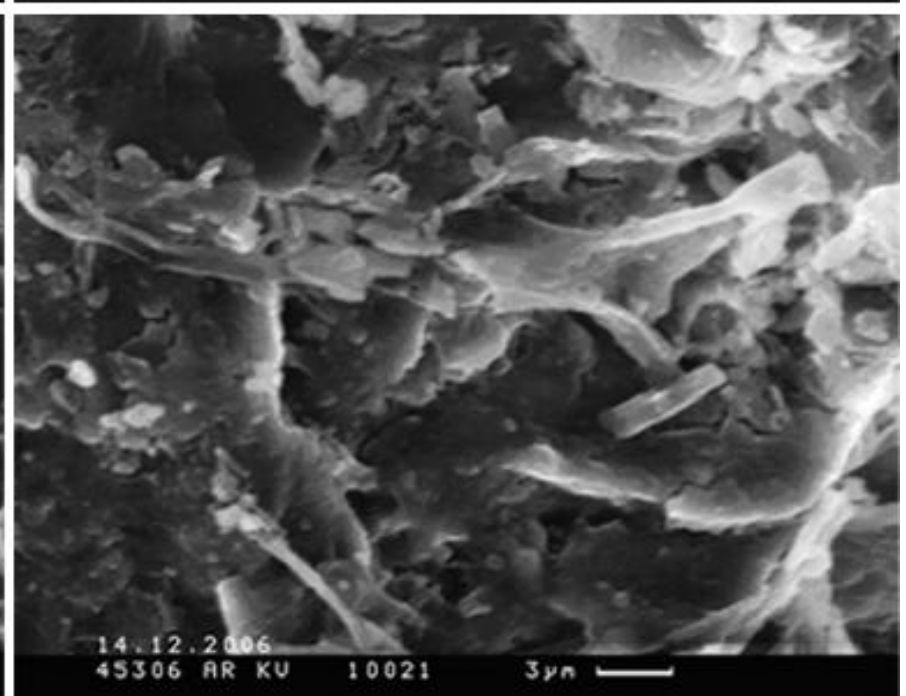
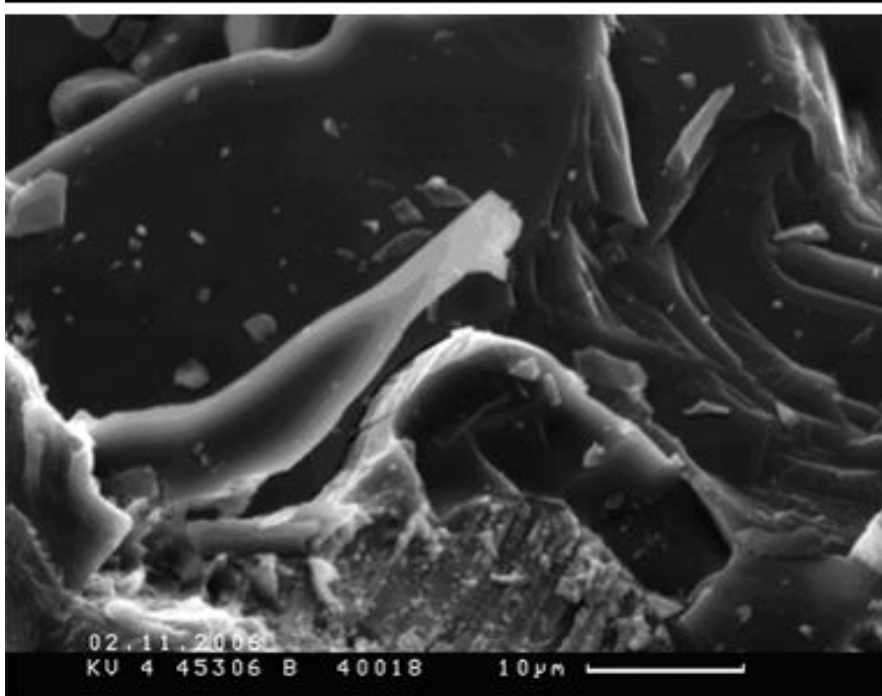
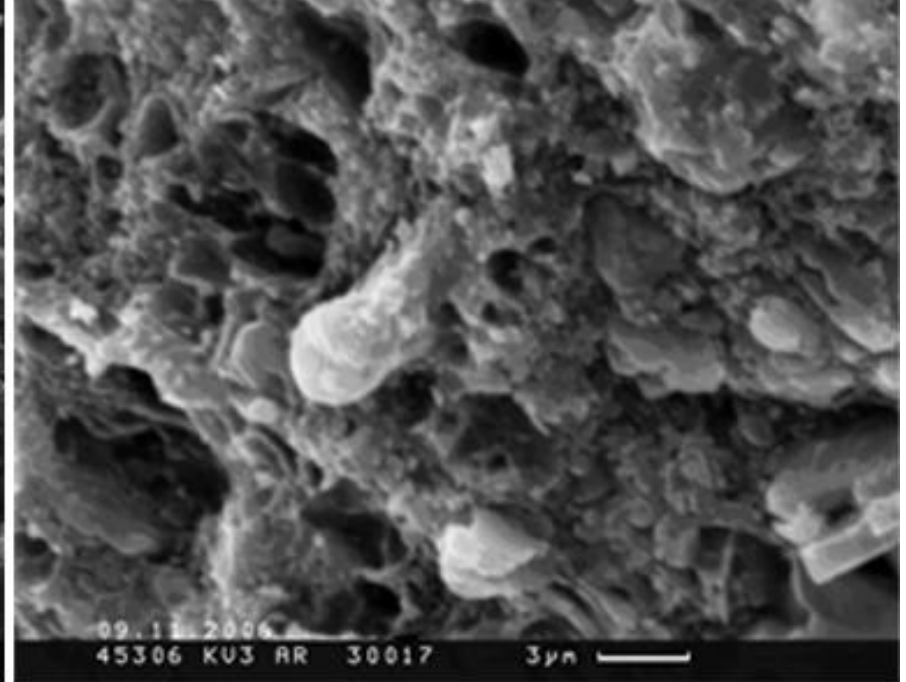
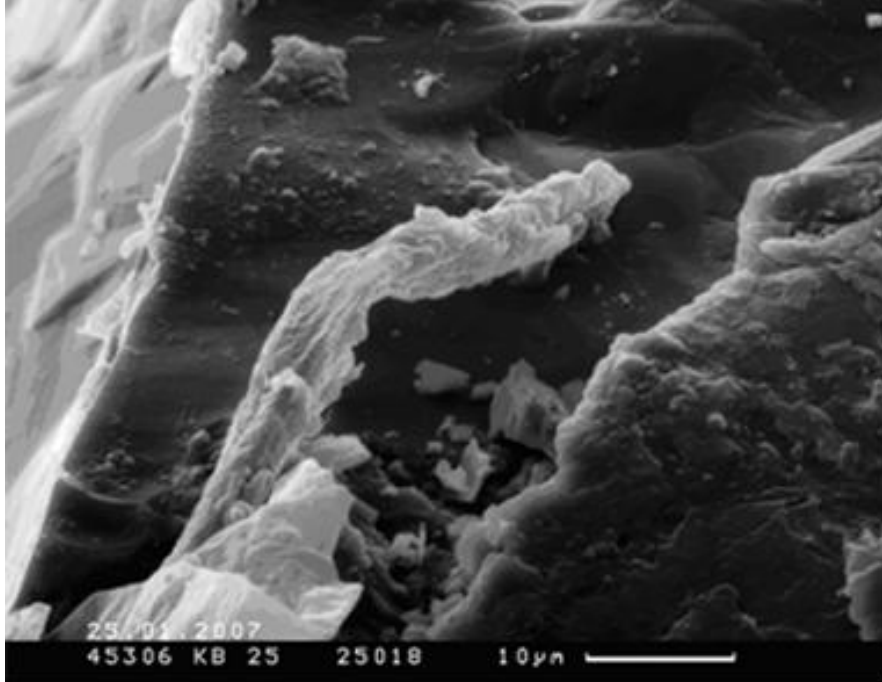
The probable evolution of atmospheric oxygen over time given the constraints discussed in the text. The solid curve is inferred from sulfur isotope MIF, the dotted curve is taken mostly from Canfield (2005). GOE is the great oxidation event of Holland (2002). Qv. Cattling and Claire (2005).



0 0.1 mm

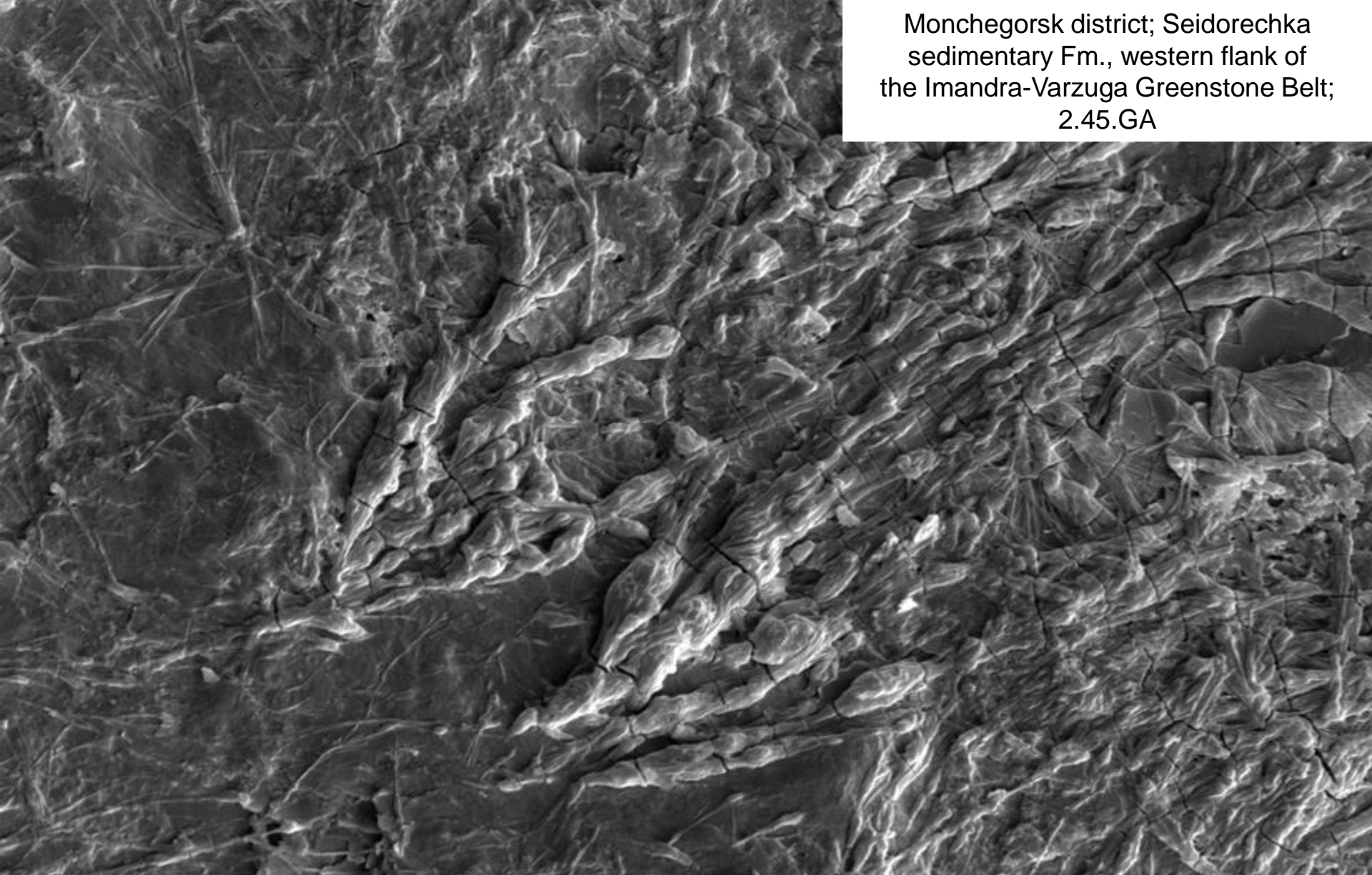
0 0.1 0.2 mm

*Left:* Detrital grains of uraninite from the Basal Reef, Loraine Gold Mines, Ltd., Orange Free State, South Africa. The grains are dusted with myriads of tiny inclusions of galena (PbS) showing up as white specks; part of the galena has been "sweated out" and forms delicate PbS-aureoles on the grain surface. *Right:* Outlines of detrital monazite grains from a West Australian beach placer. Note the resemblance in shape between abrasion forms of uraninite on the left and these detrital "muffin-shaped" monazite grains.



Paleosoils, 2.4 GA, Paanajarvi lake (Northern Karelia)

Monchegorsk district; Seidorechka  
sedimentary Fm., western flank of  
the Imandra-Varzuga Greenstone Belt;  
2.45.GA



20µm



EHT = 20.00 kV

WD = 14.5 mm

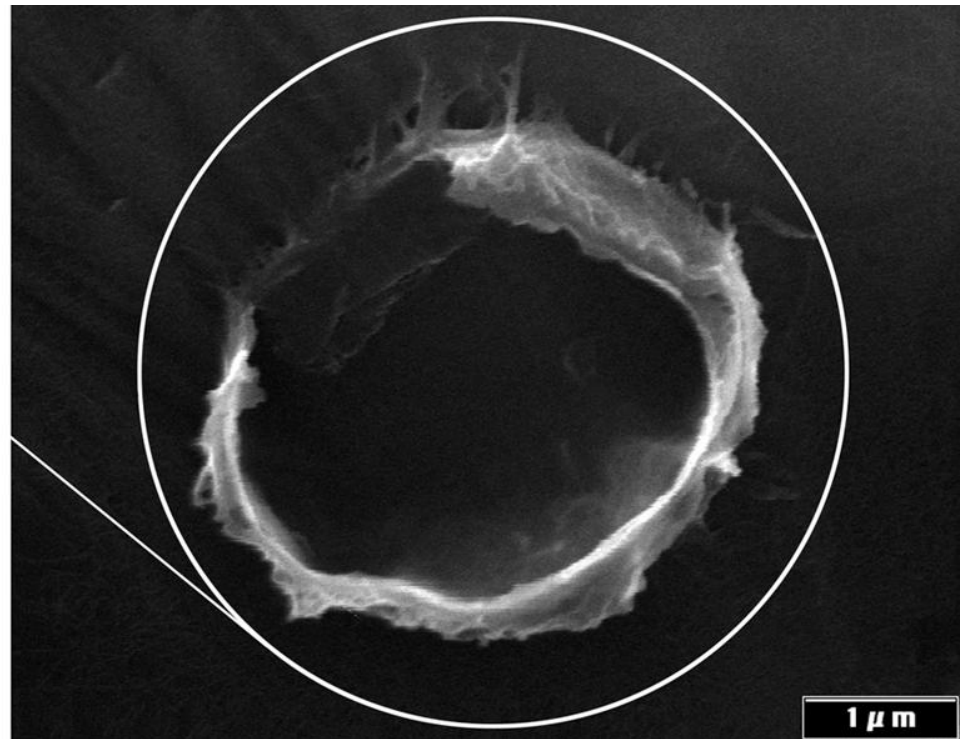
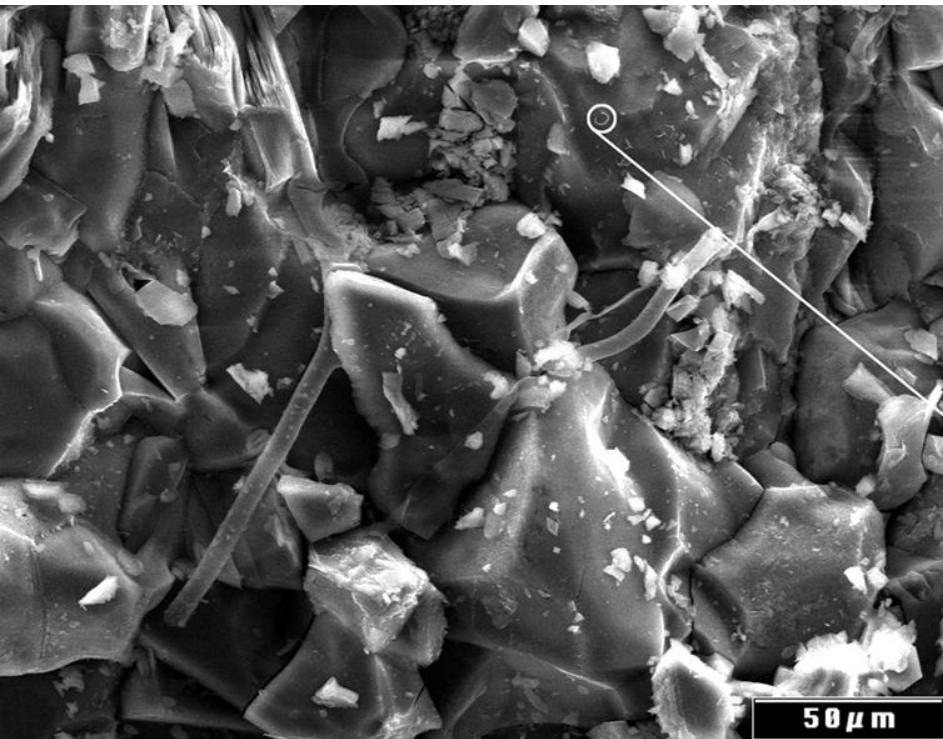
Signal A = SE1

Photo No. = 1236

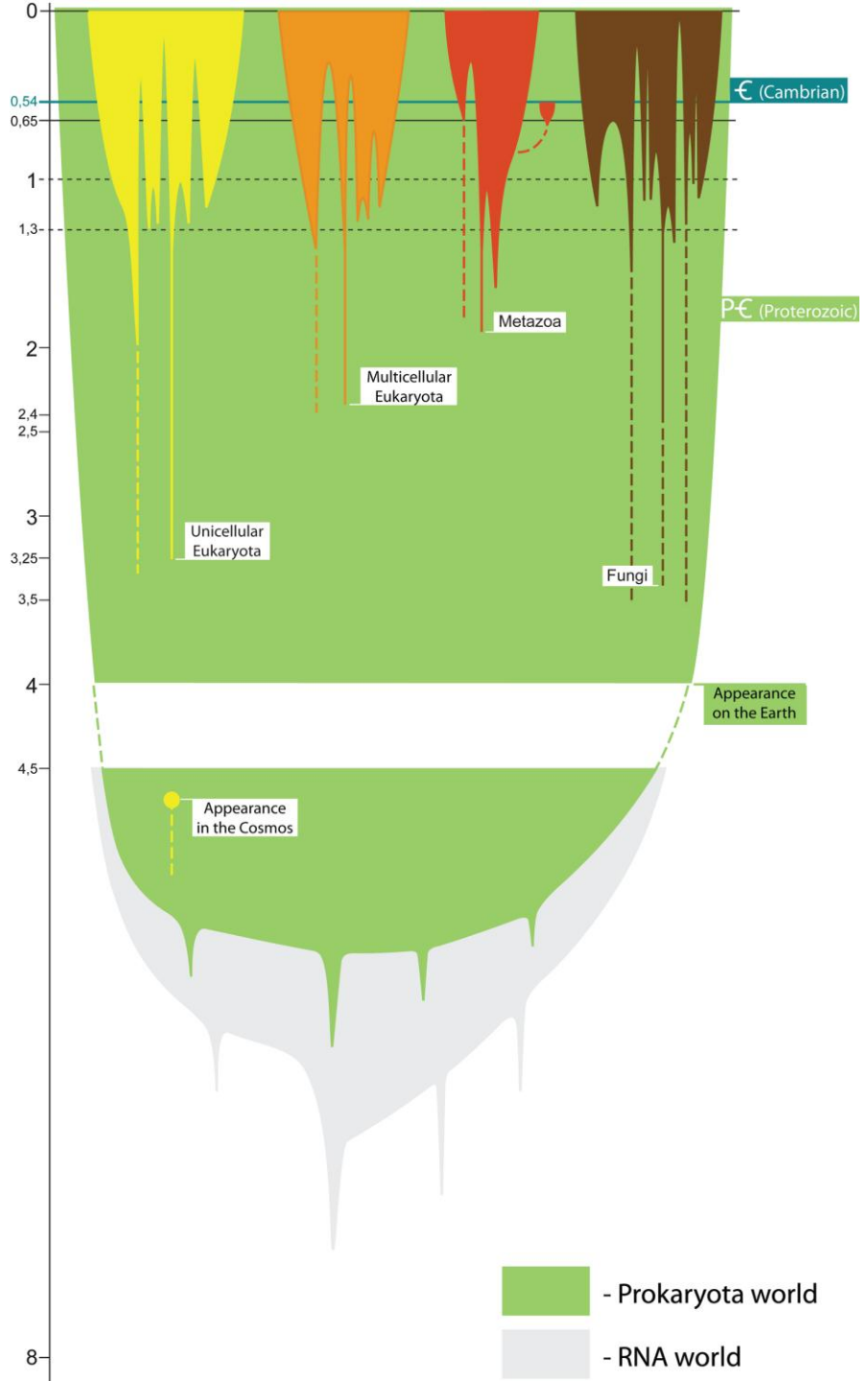
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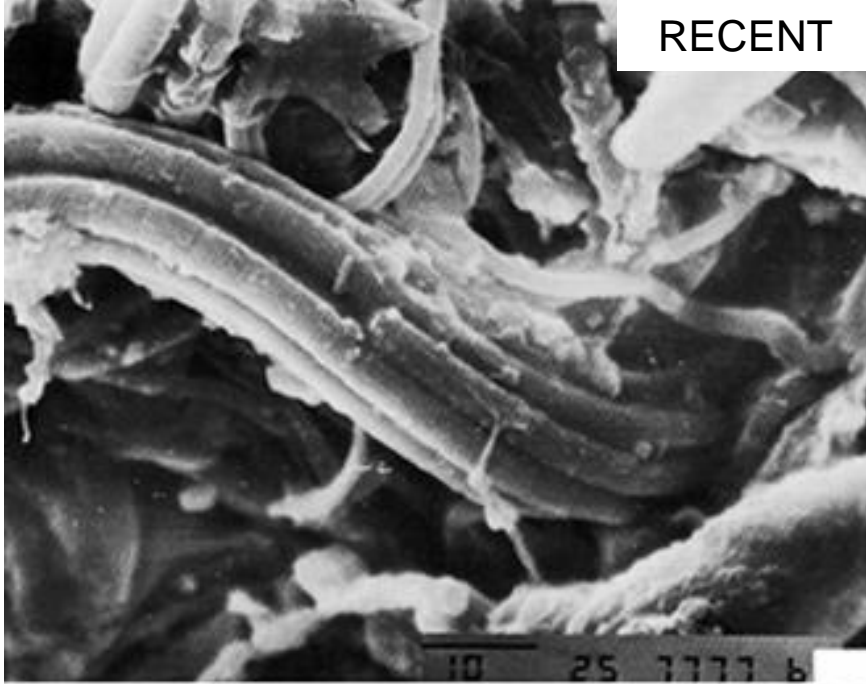


Cyanobacterial tubes in the Lopian rocks. Tubes lie horizontally on the surface of the microlayer. The circle marks a cross section of the tube arranged vertically in the grain

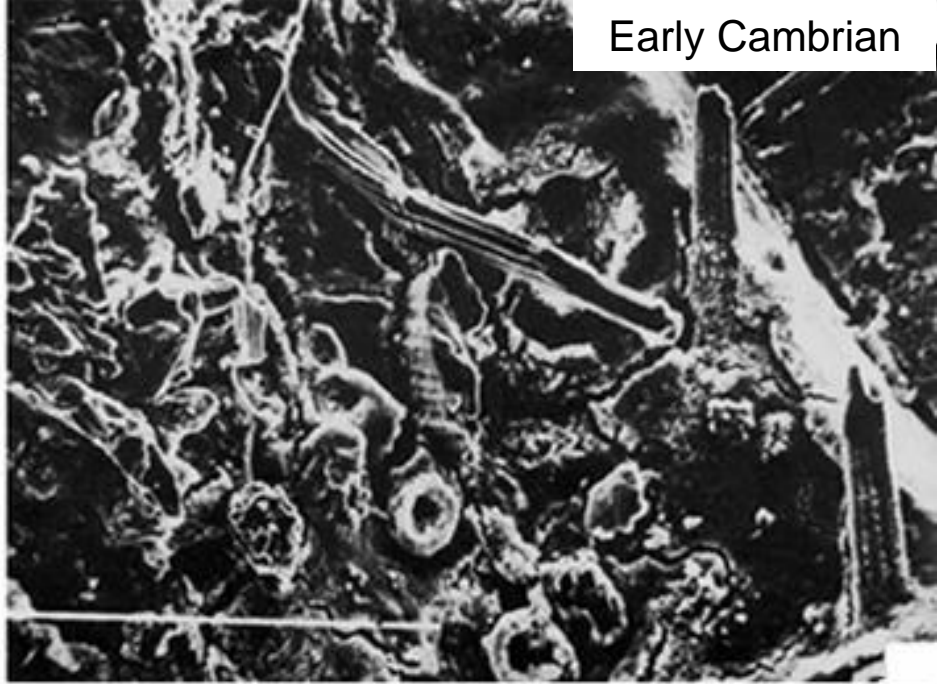


**2**

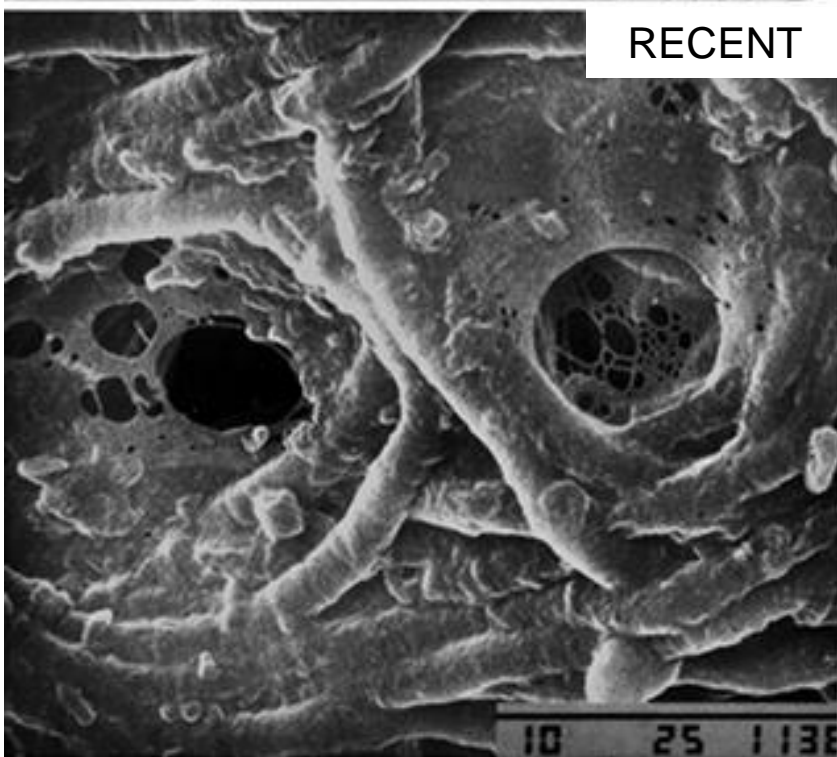
RECENT



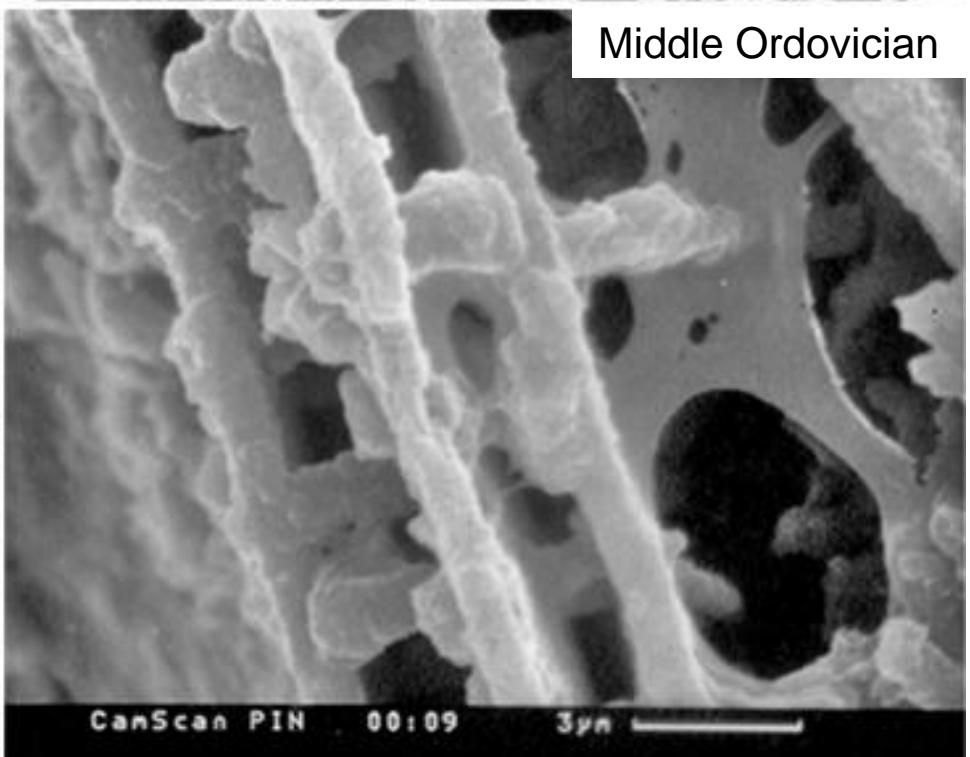
Early Cambrian

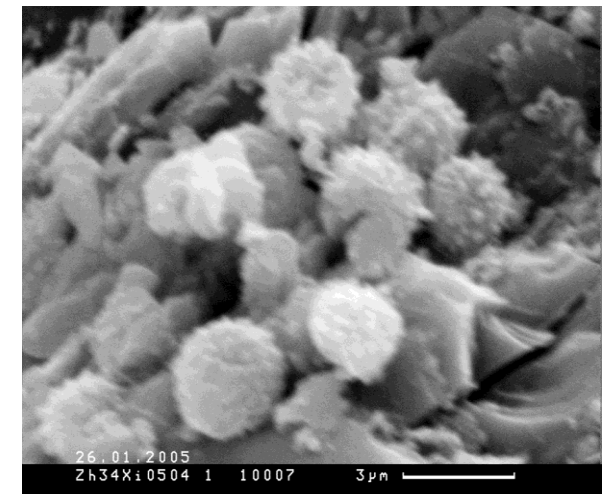
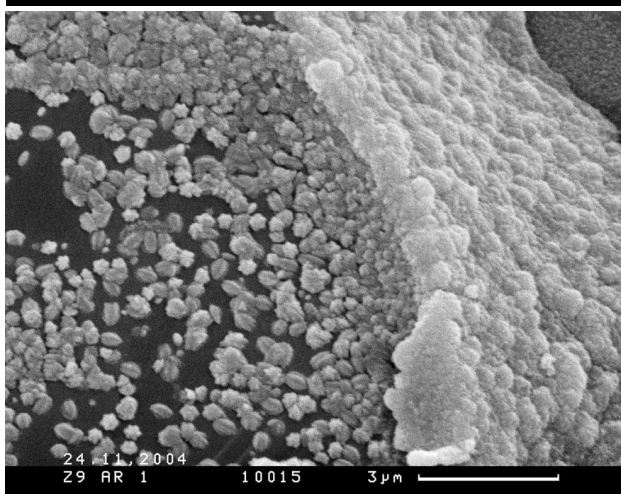
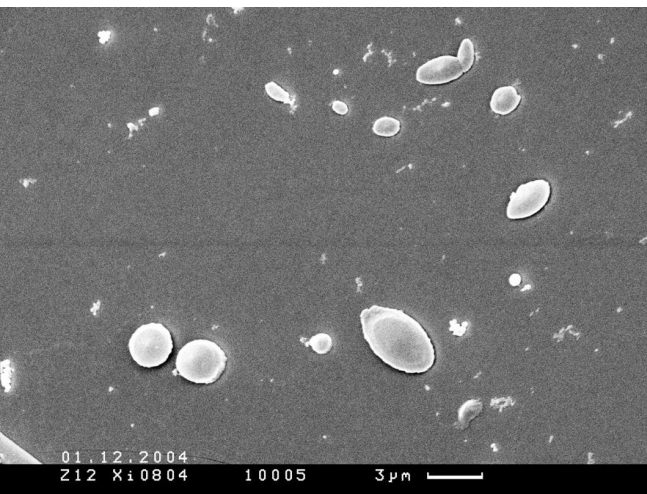
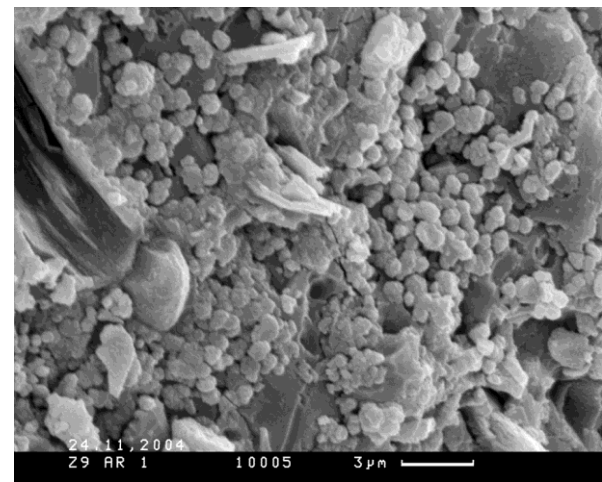
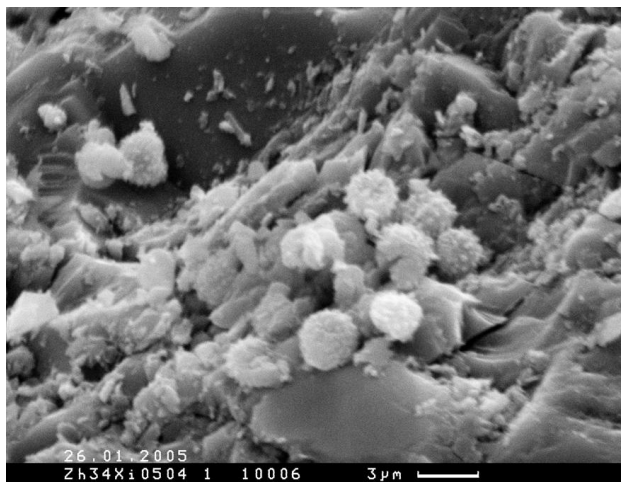
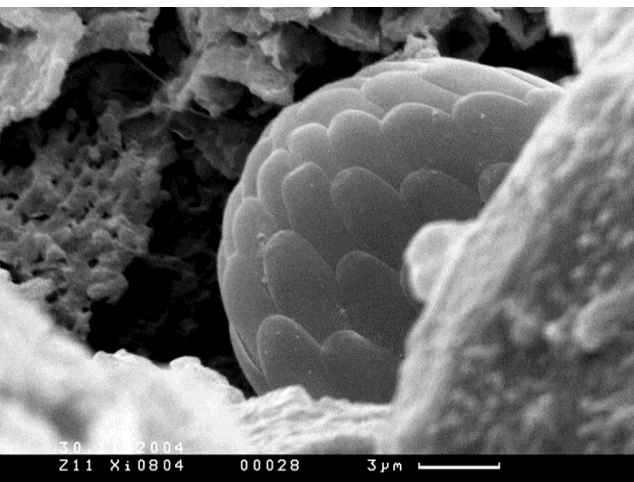


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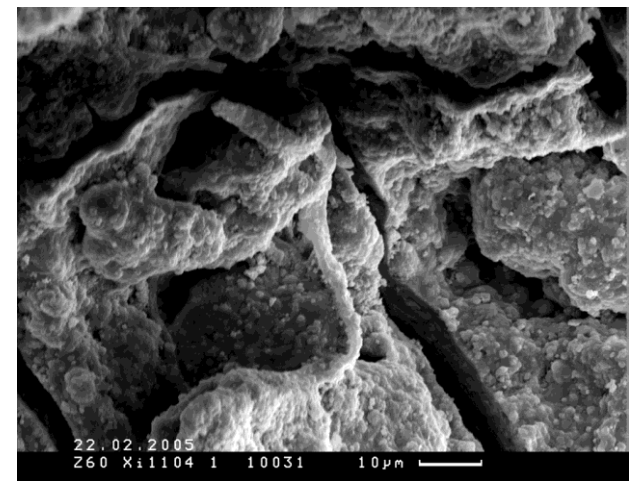
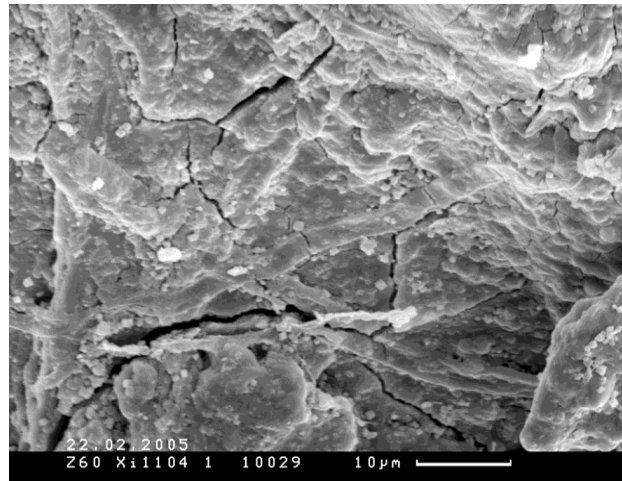
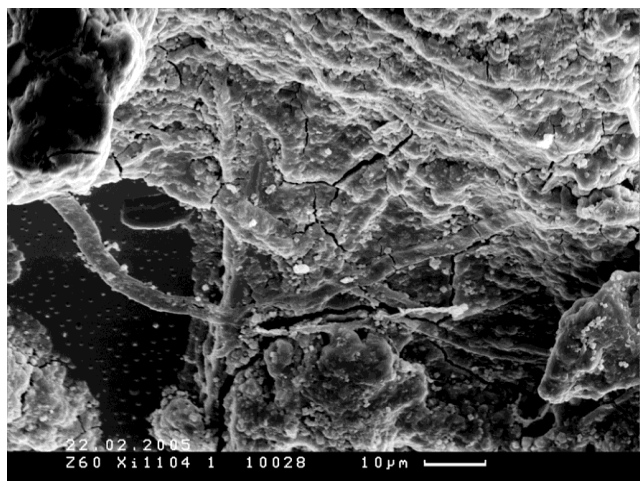
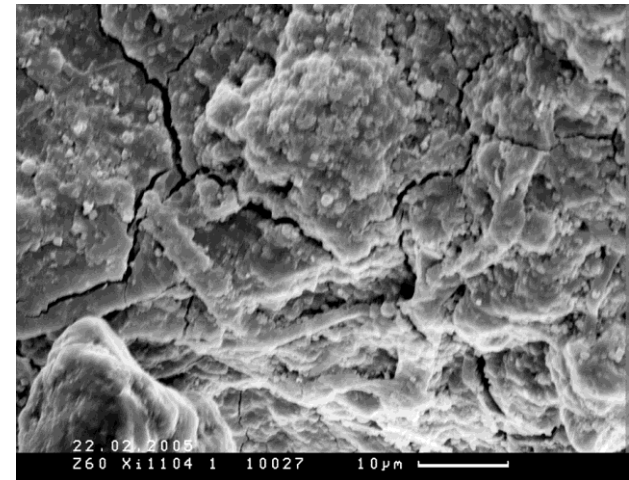
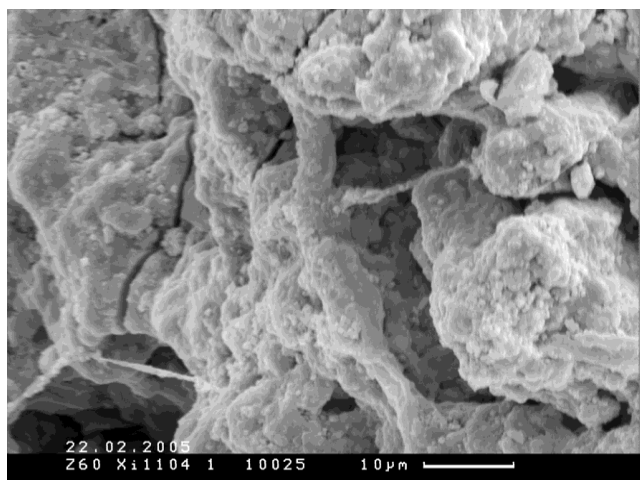


Middle Ordovician

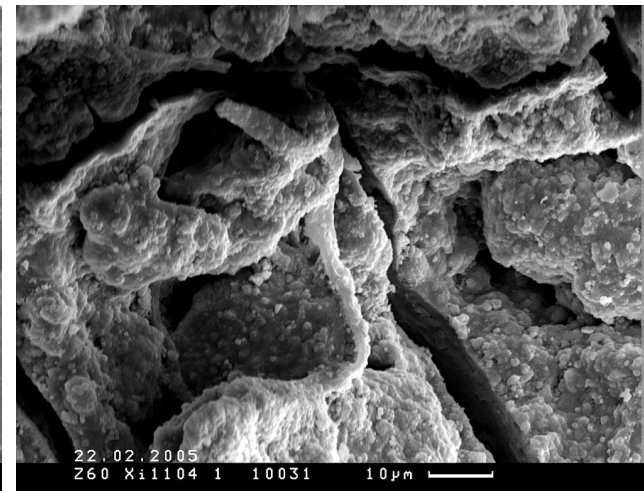
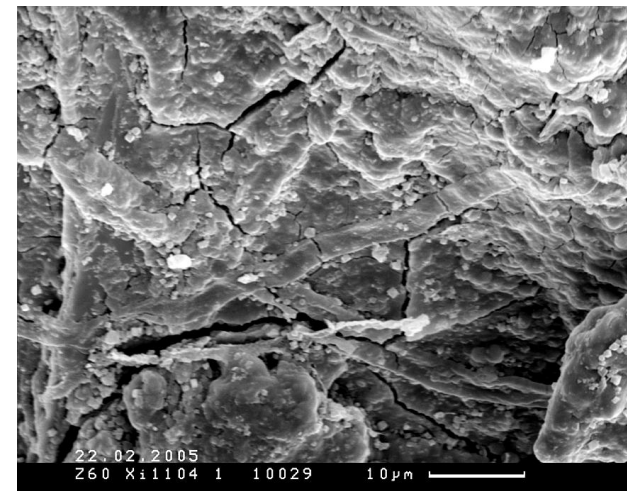
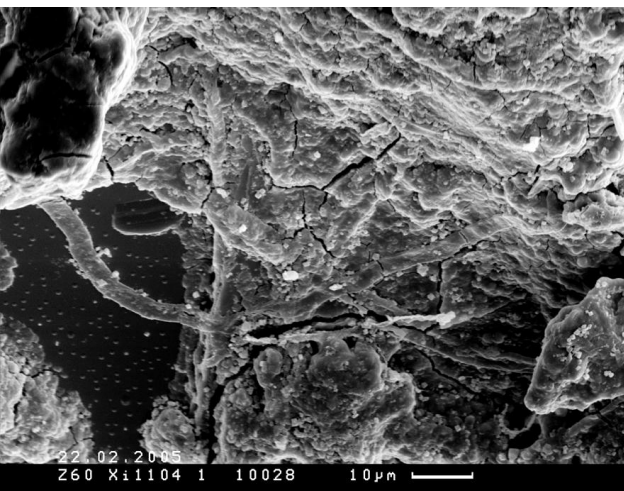
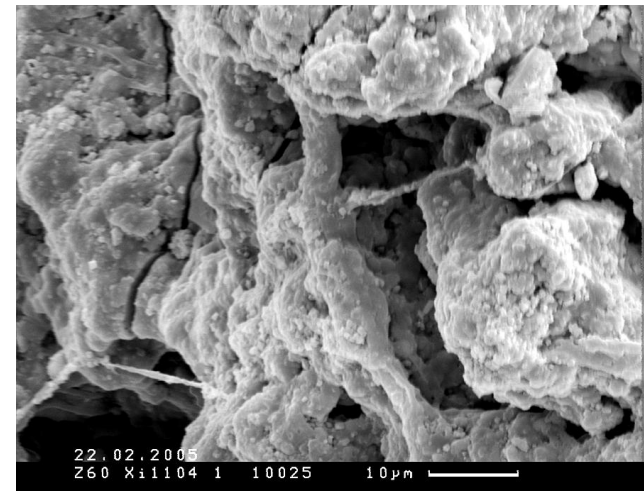
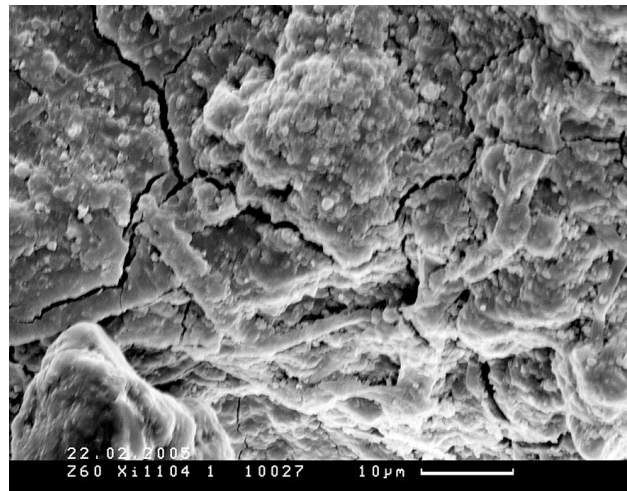




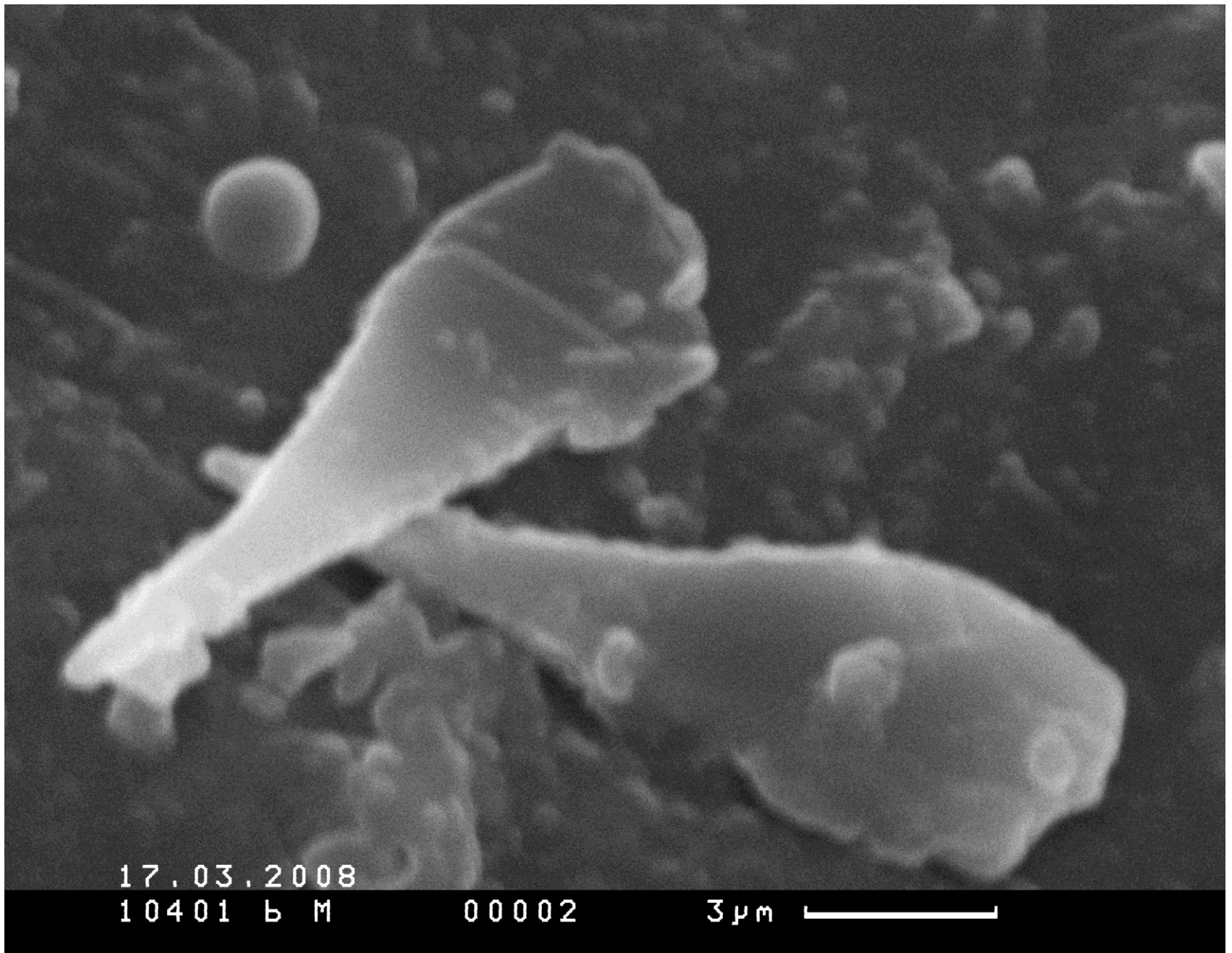
**SEM, AR, 2.9 GA, KARELIA**



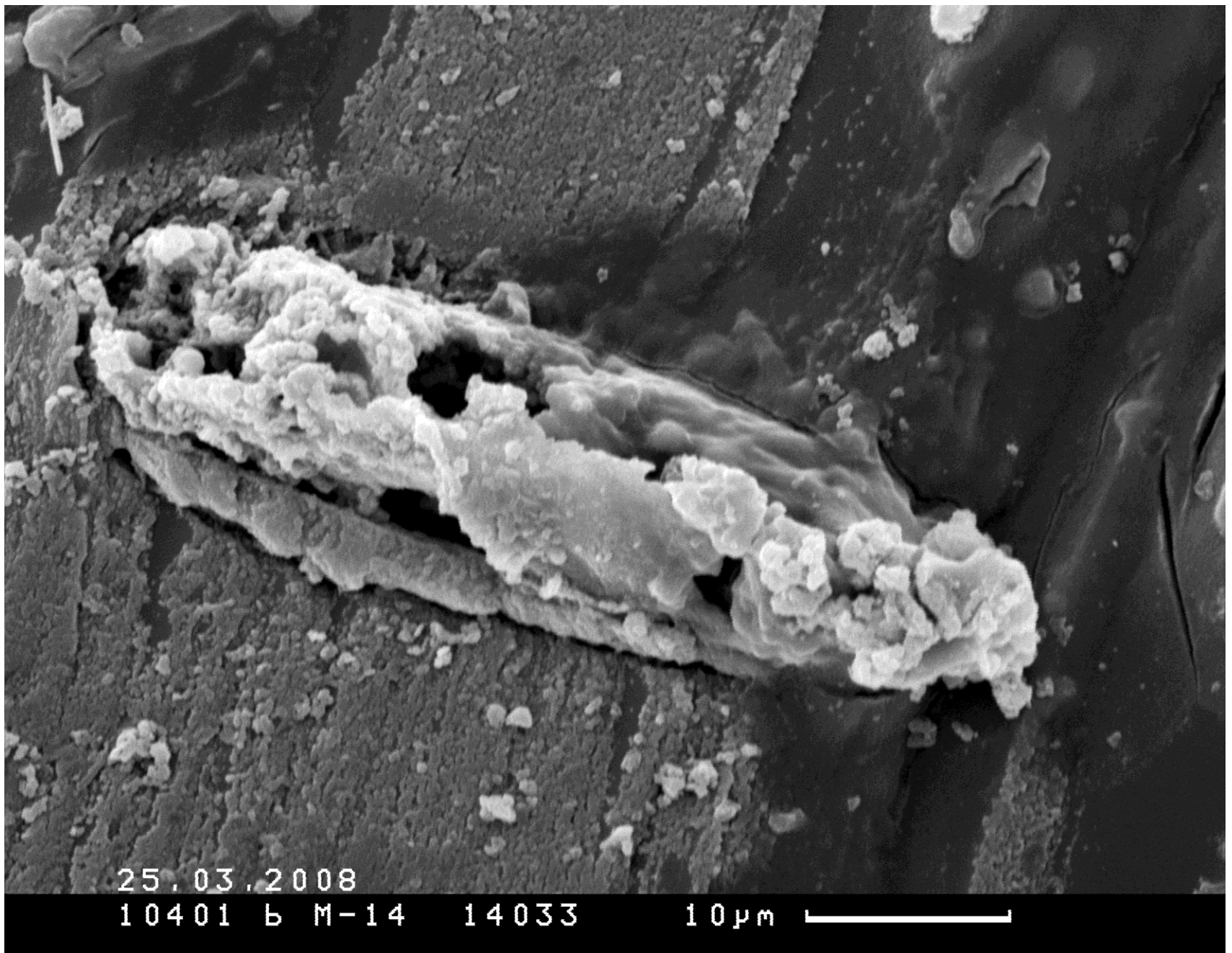
**SEM, AR, 2.9 GA, KARELIA**



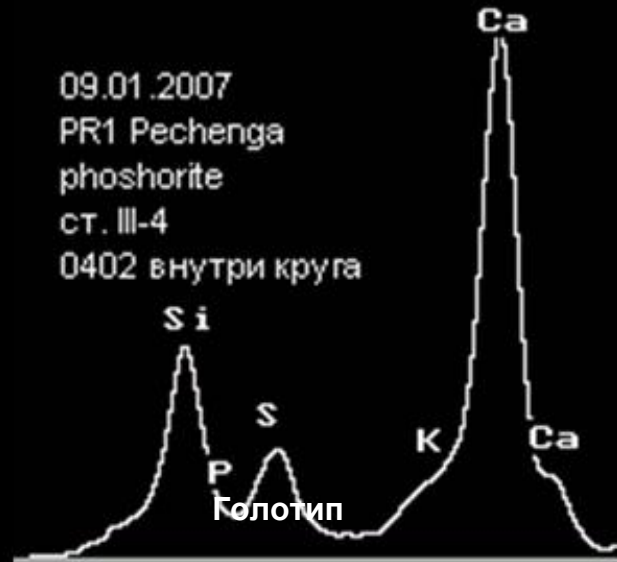
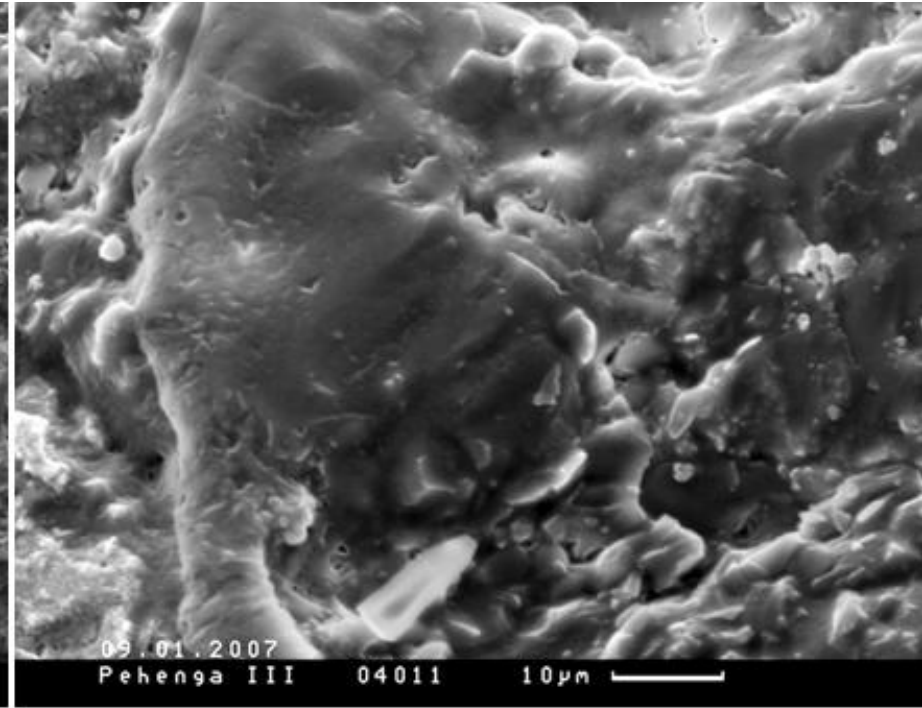
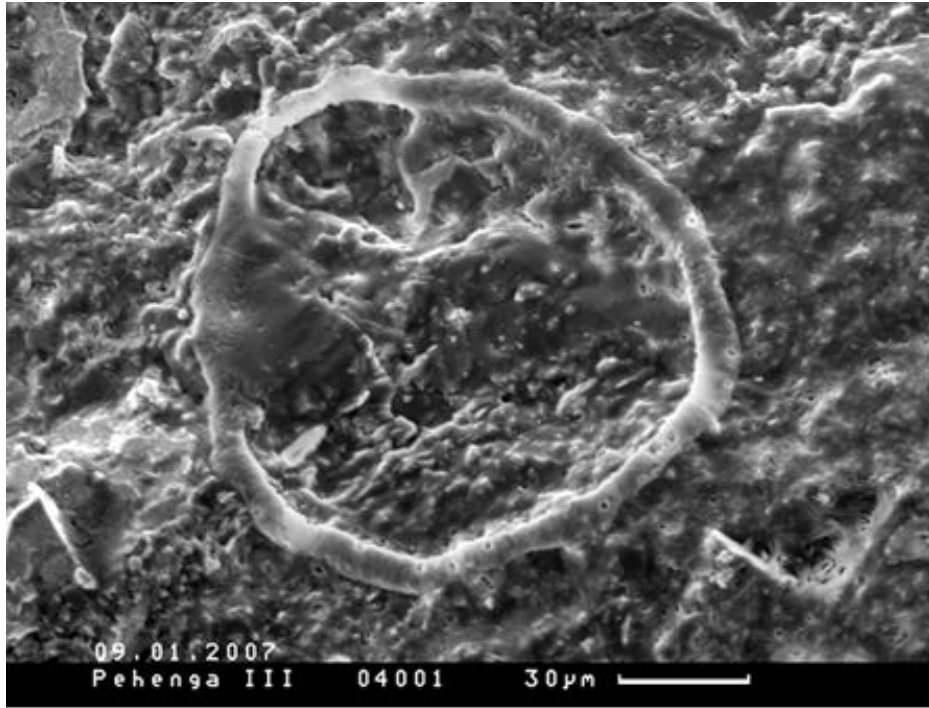
AR, 2.9 Ga, Karelia, SEM

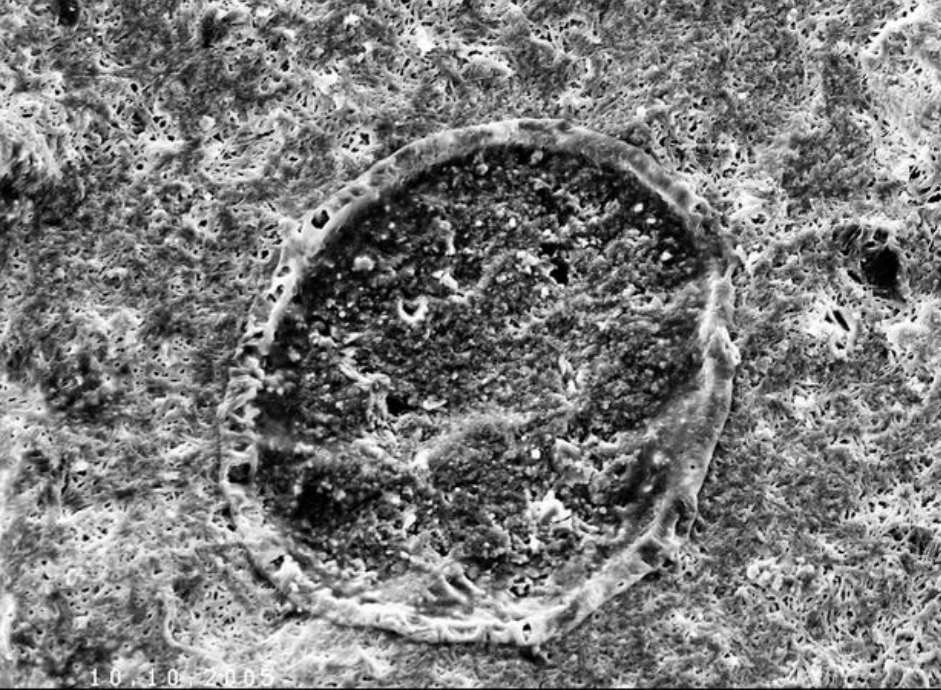


2.8 млрд лет; Воронье.

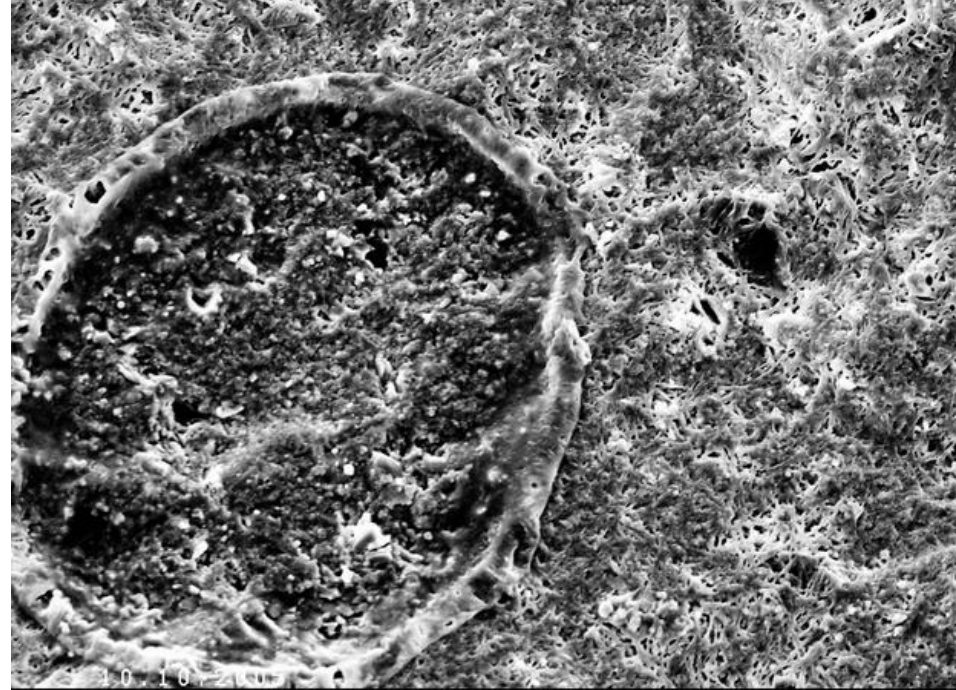


2.8 млрд лет; Воронье.

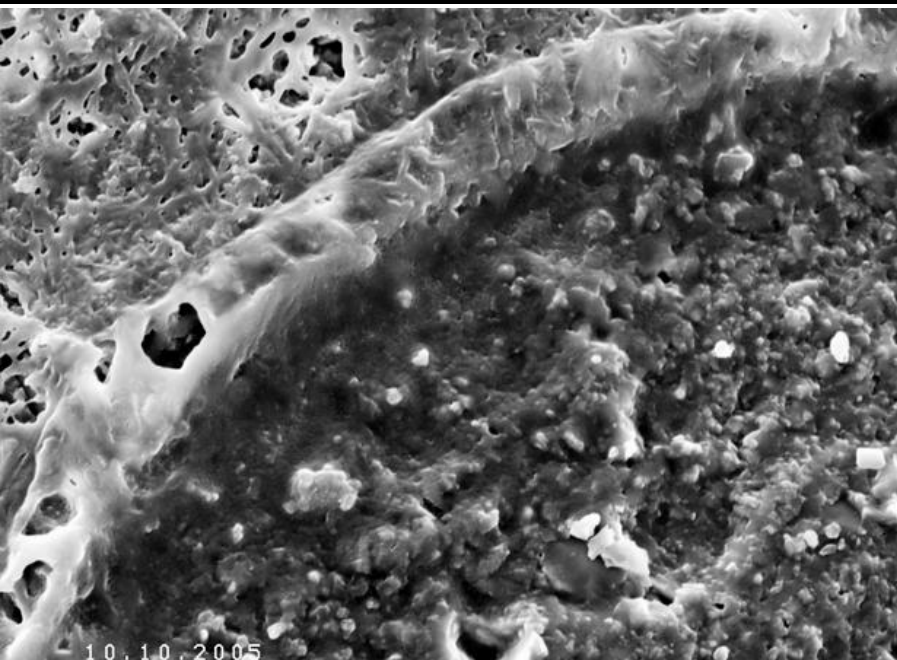




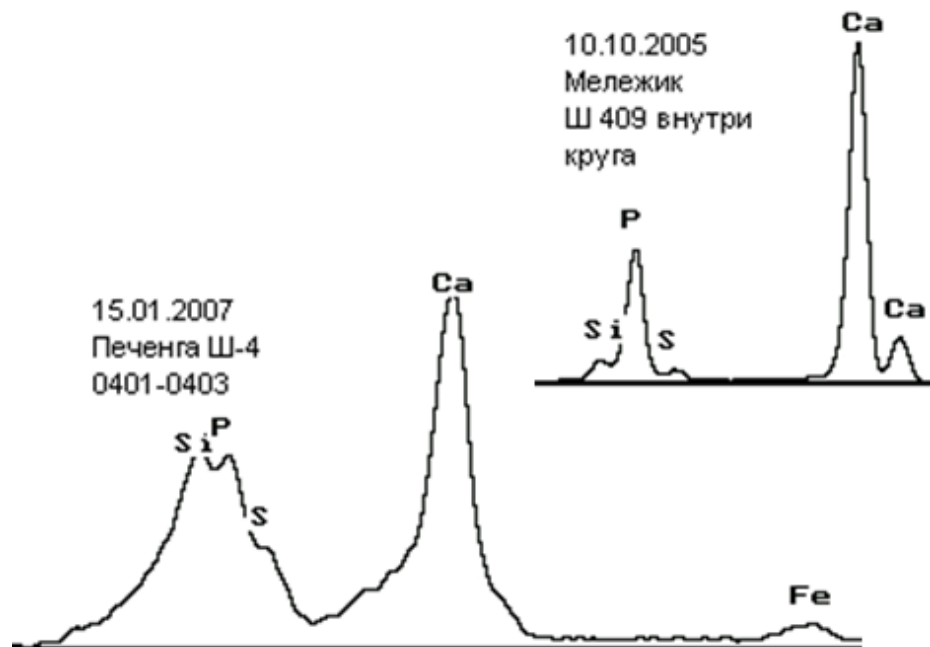
10.10.2005  
Pechenga III 40009 30µm

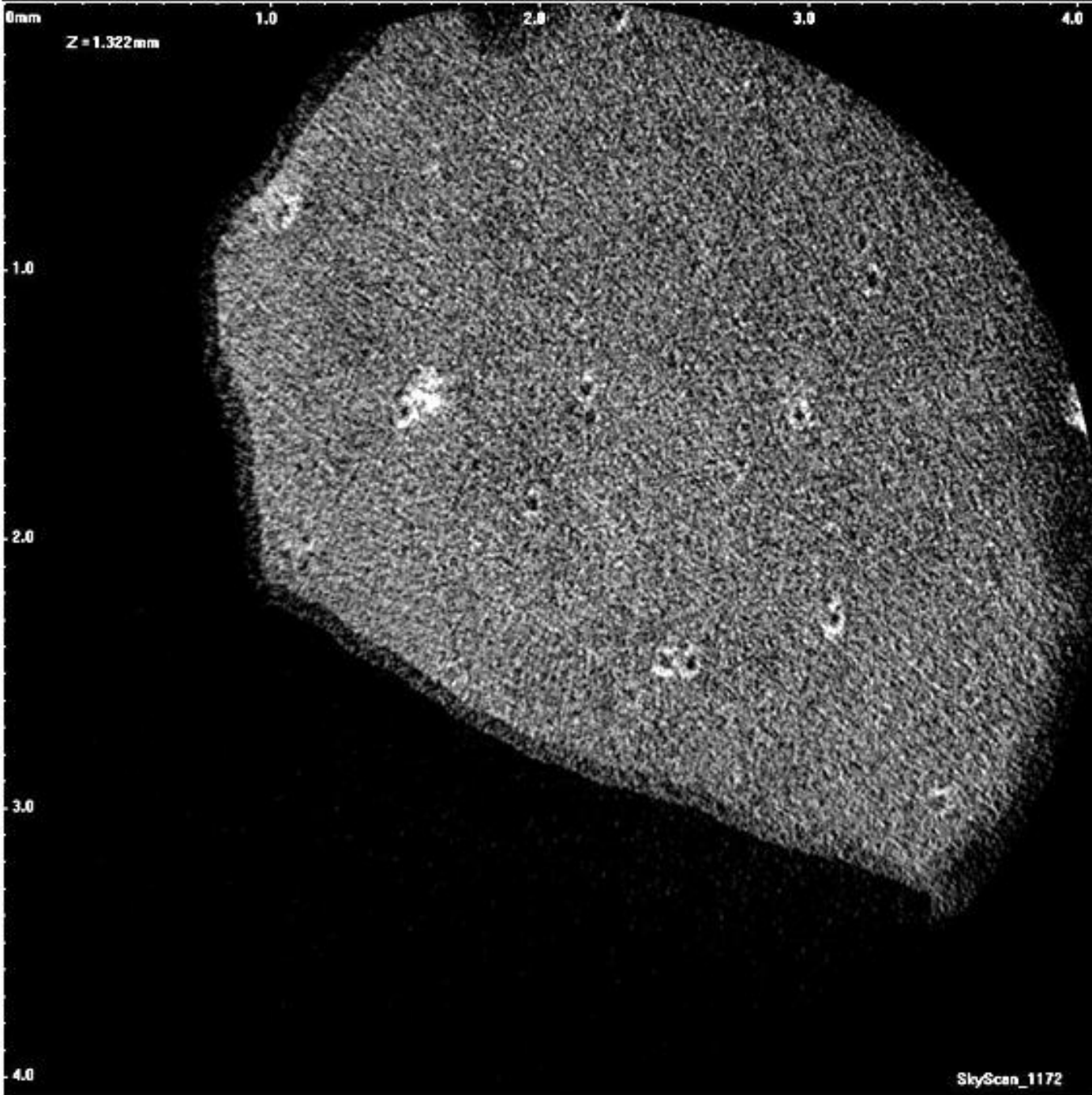


10.10.2005  
Pechenga III 40010 30µm



10.10.2005  
Pechenga III 40011 10µm

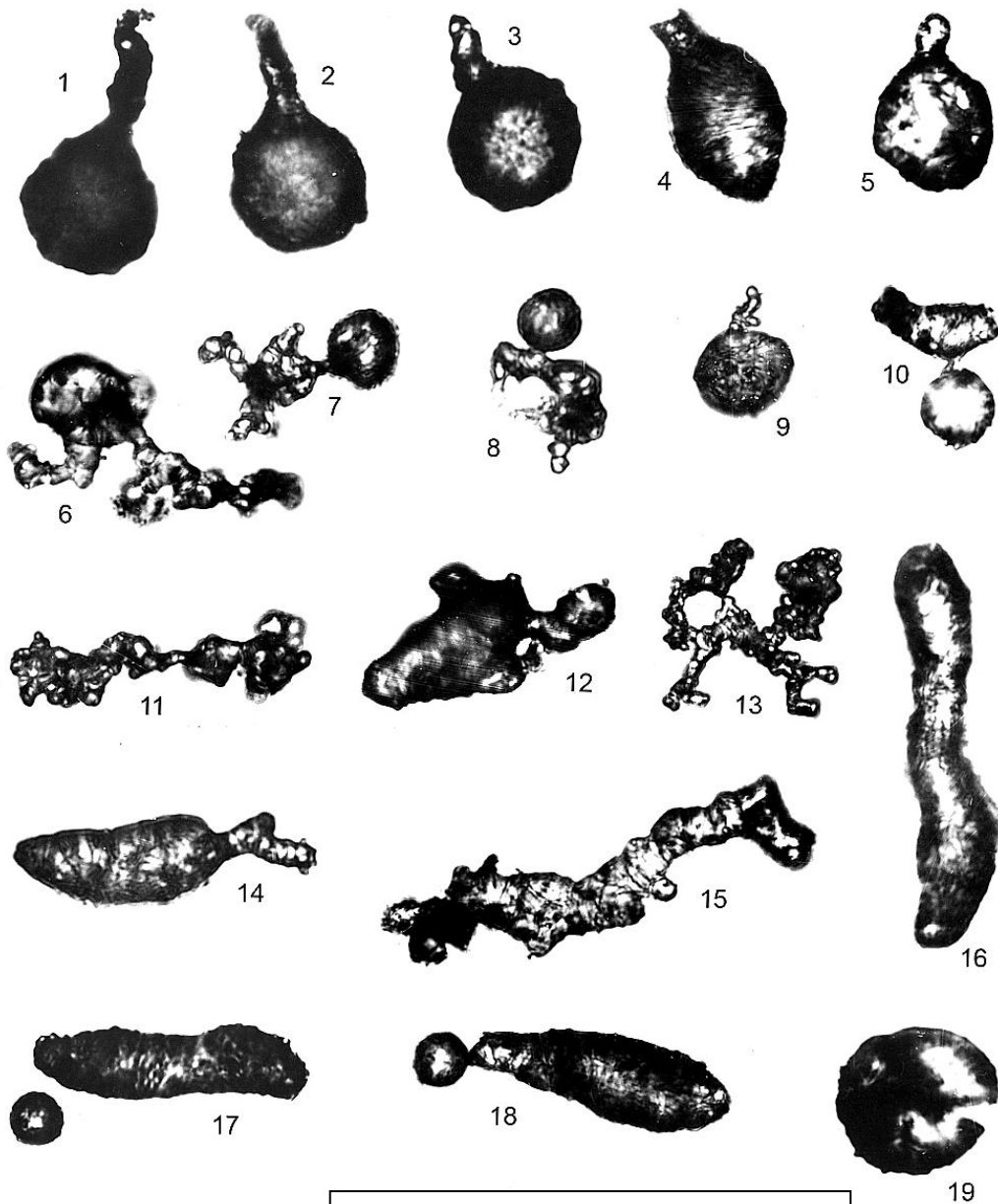




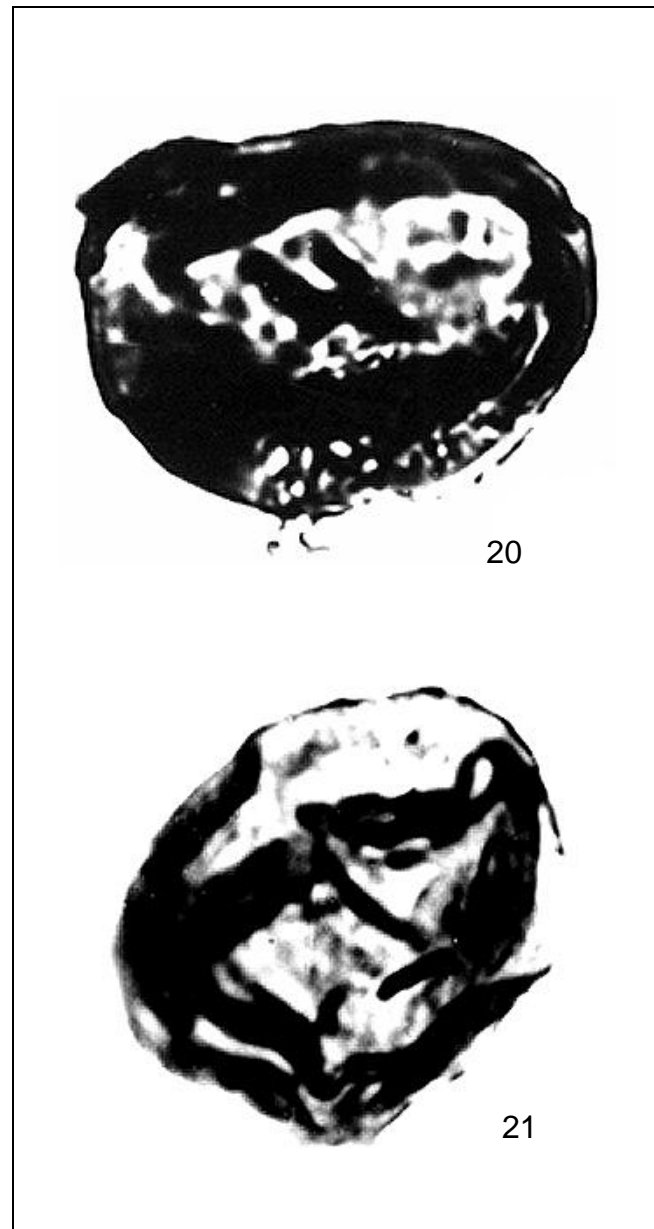
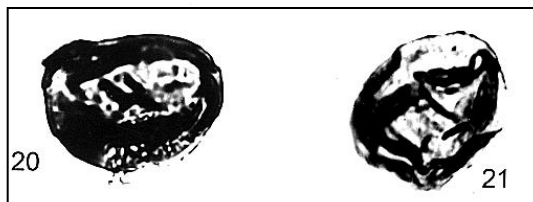
*Pechengia* g.n., ~2,0 Ga; 3D, Tomography

2 – 2,2 Ga

(Белова, Ахмедов, 2006)



20 MKM



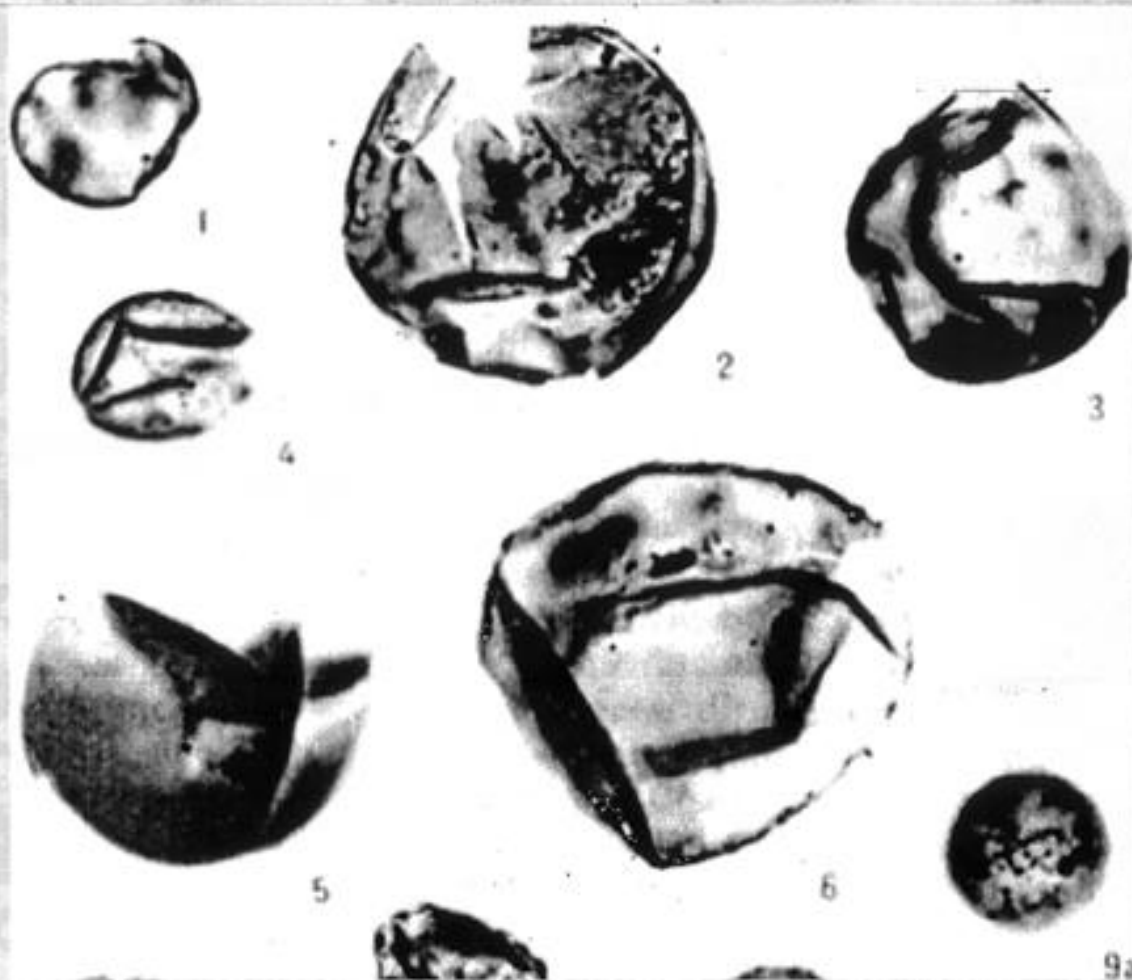


Udocania; ~2 Ga

**3**



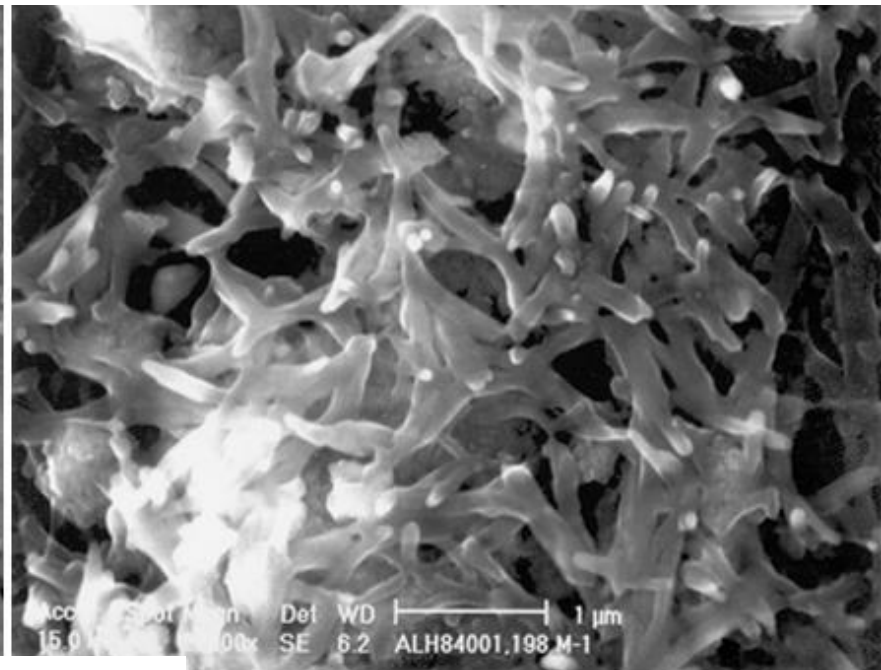
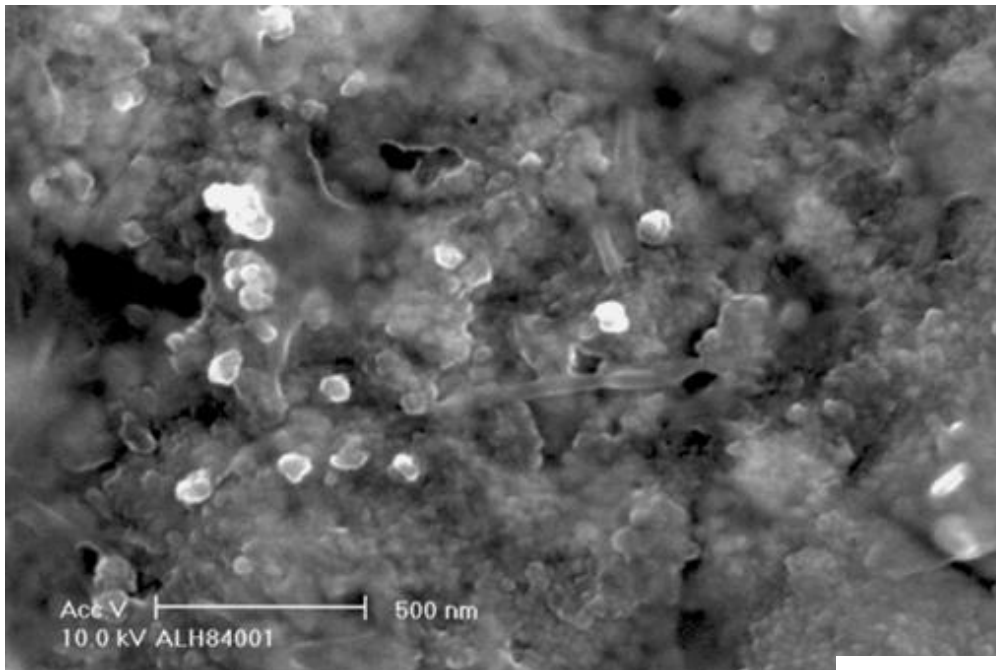
# Detection of Microfossils in Meteorites - *Mighei*



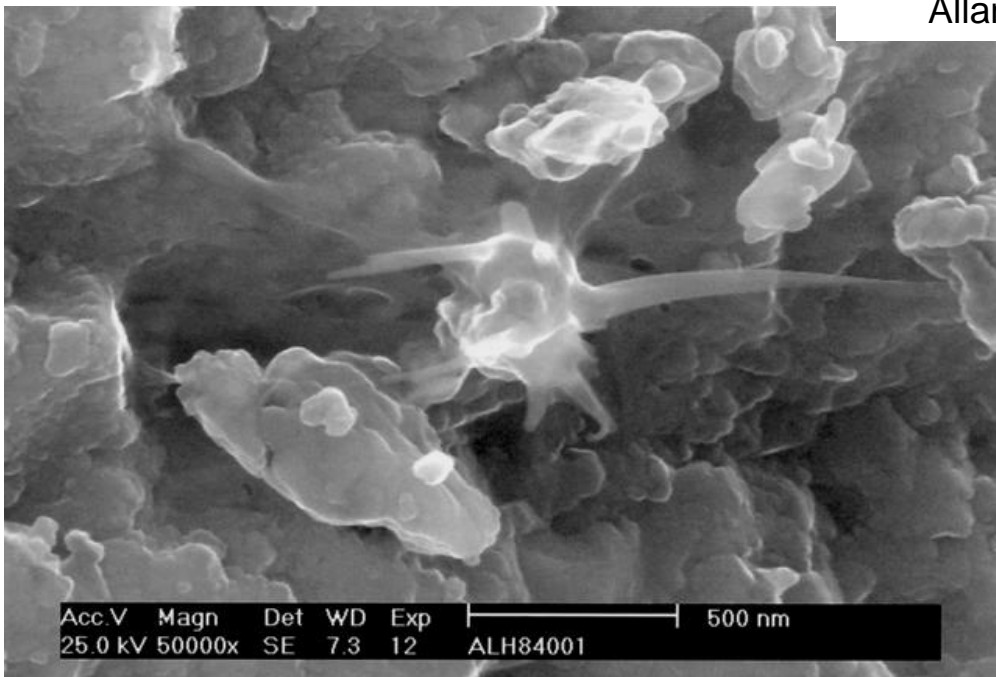
Acritarch-like Microfossils in Mighei *Timofejev 1963*

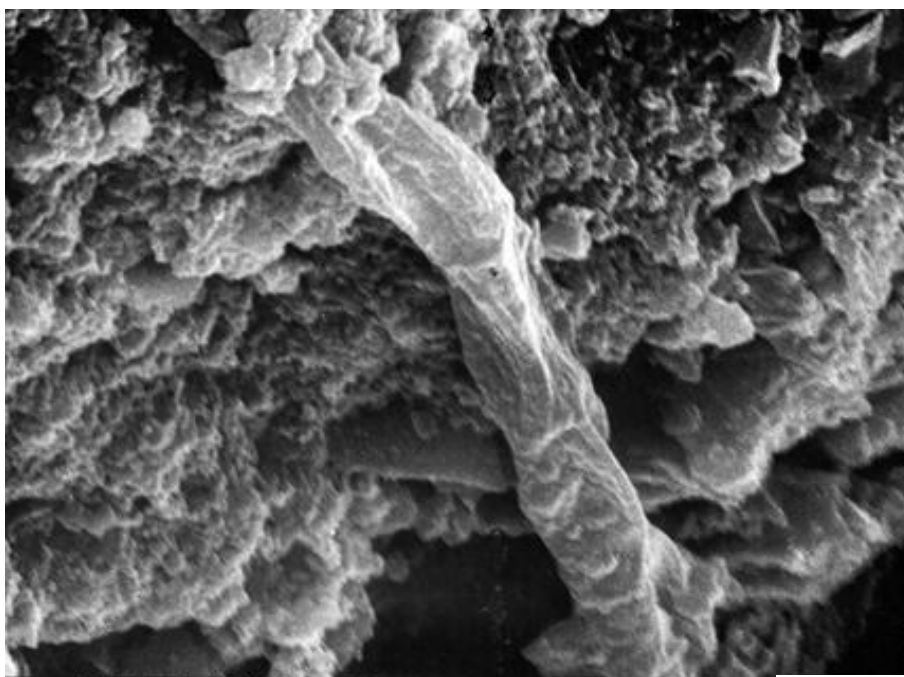


An elongated, segmented structure that typifies the larger of such structures ( $\sim 0.1 \mu\text{m}$  long) found in the martian meteorite ALH84001.  
A martian fossil? Probably not.



Allan Hills

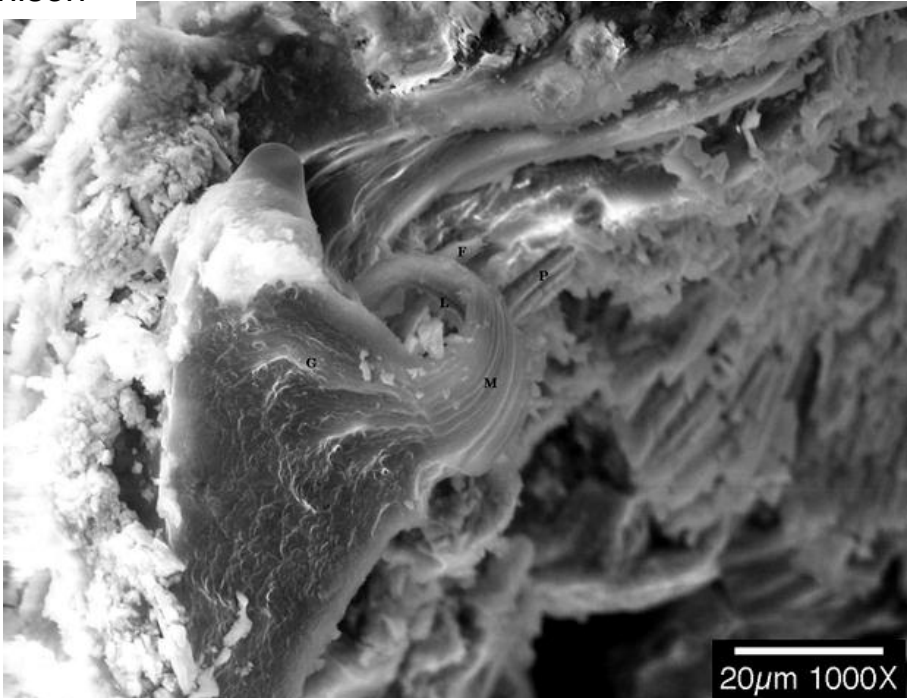
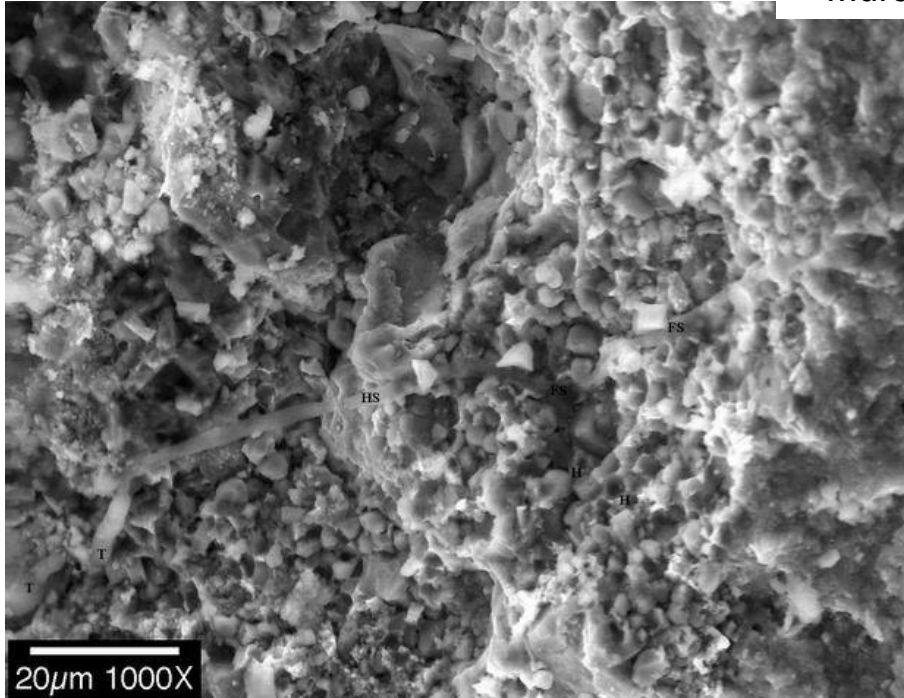




CM-2 M-15167 88:12 3µm

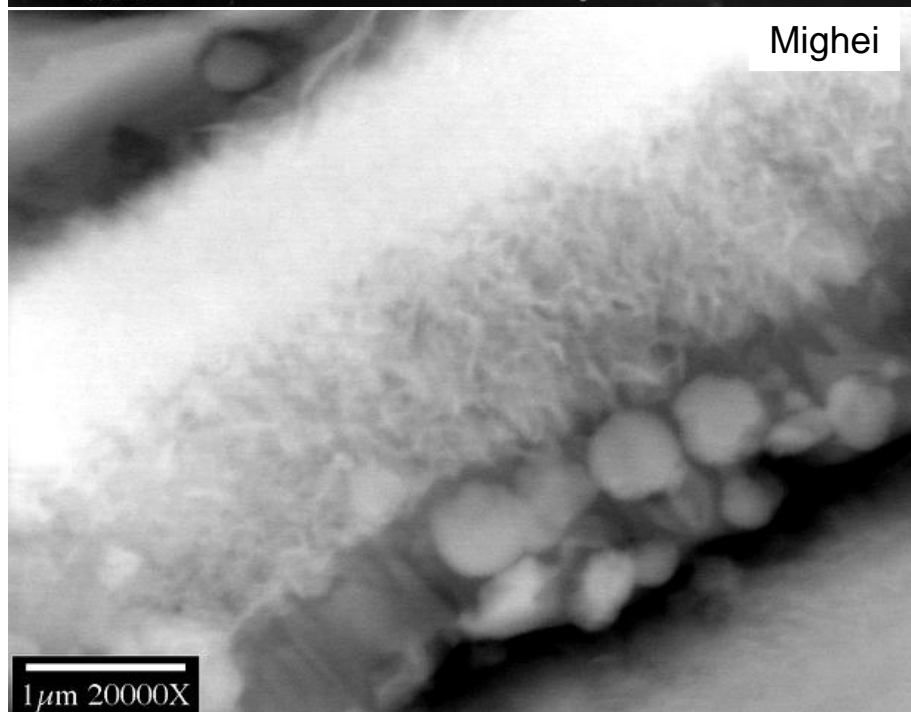
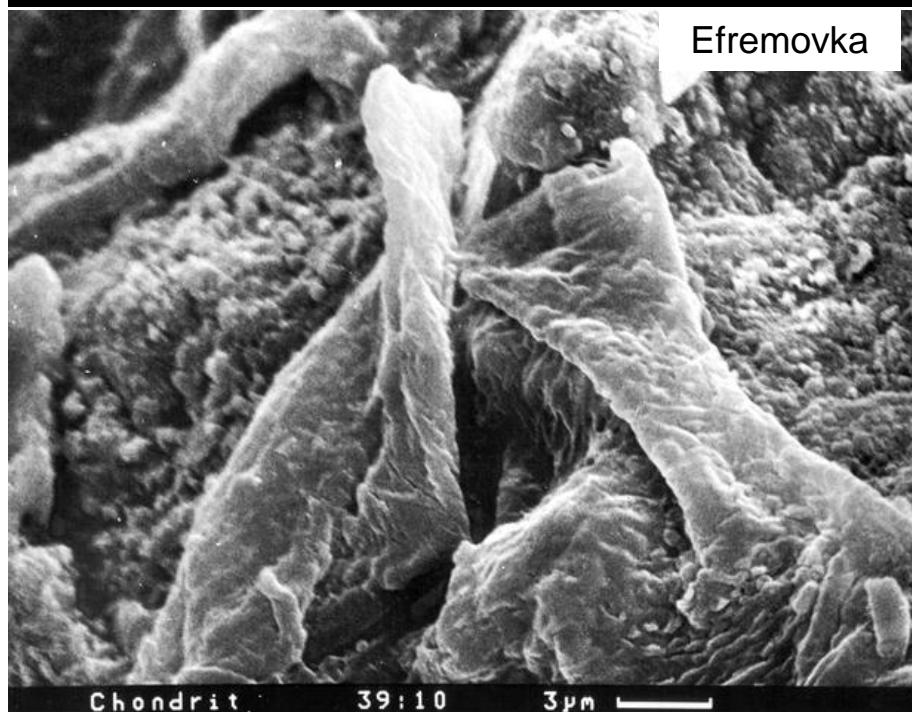
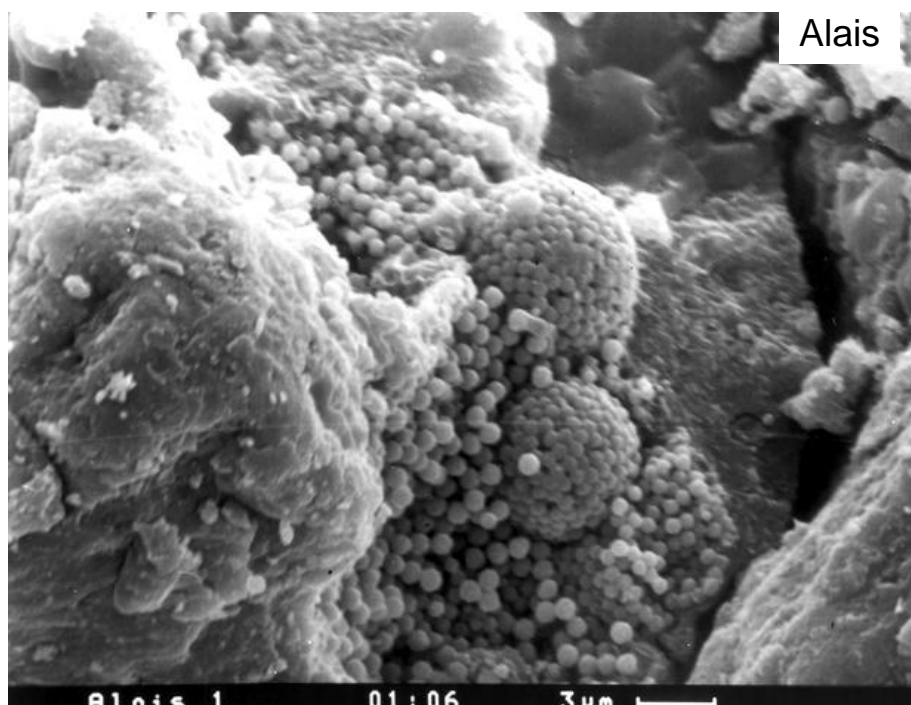
5167 CM-2 78:01 3µm

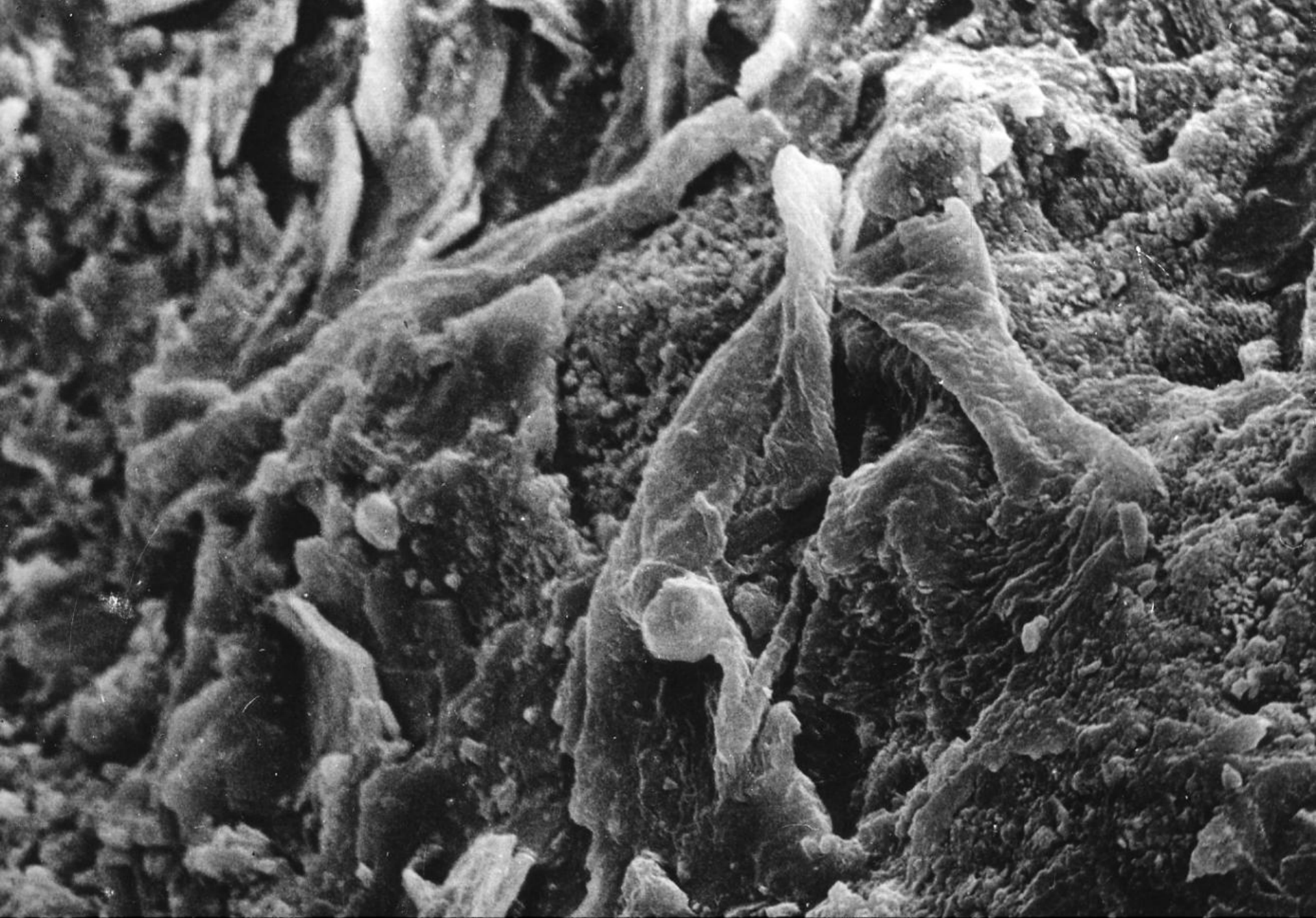
Murchison



20µm 1000X

20µm 1000X



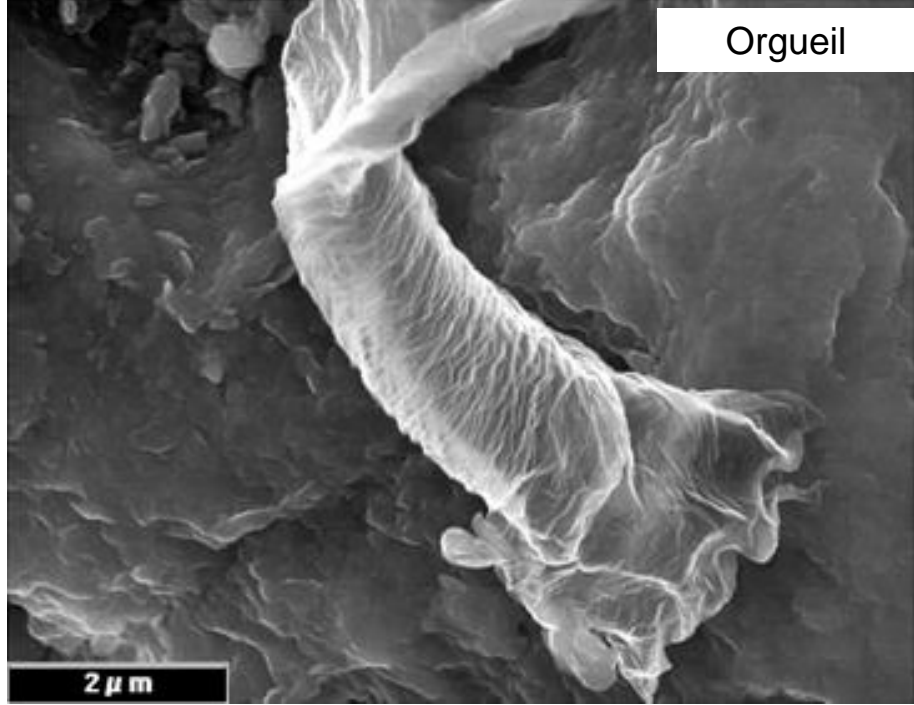
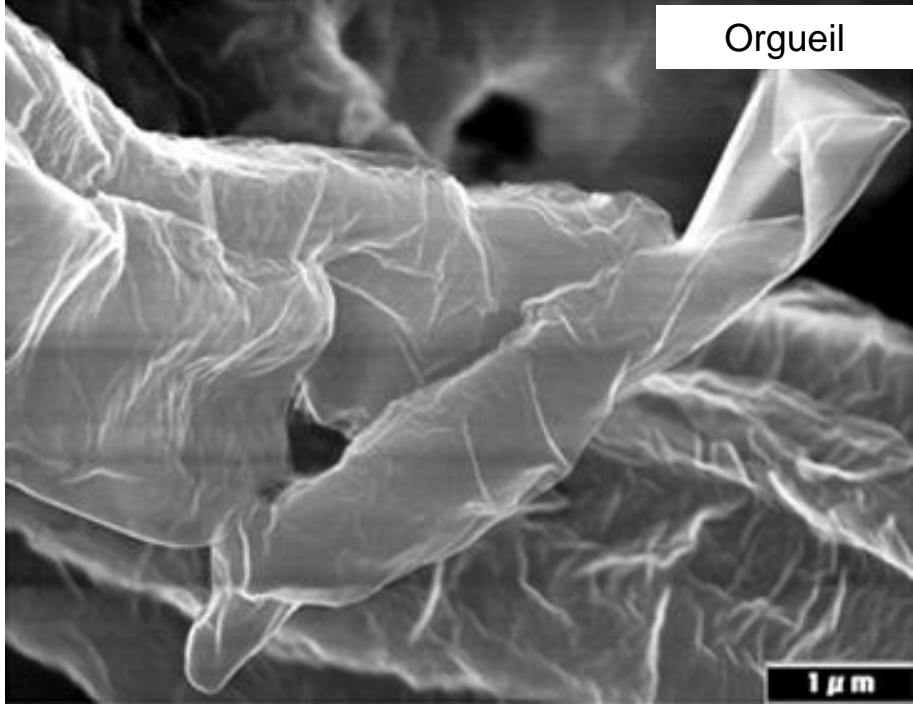
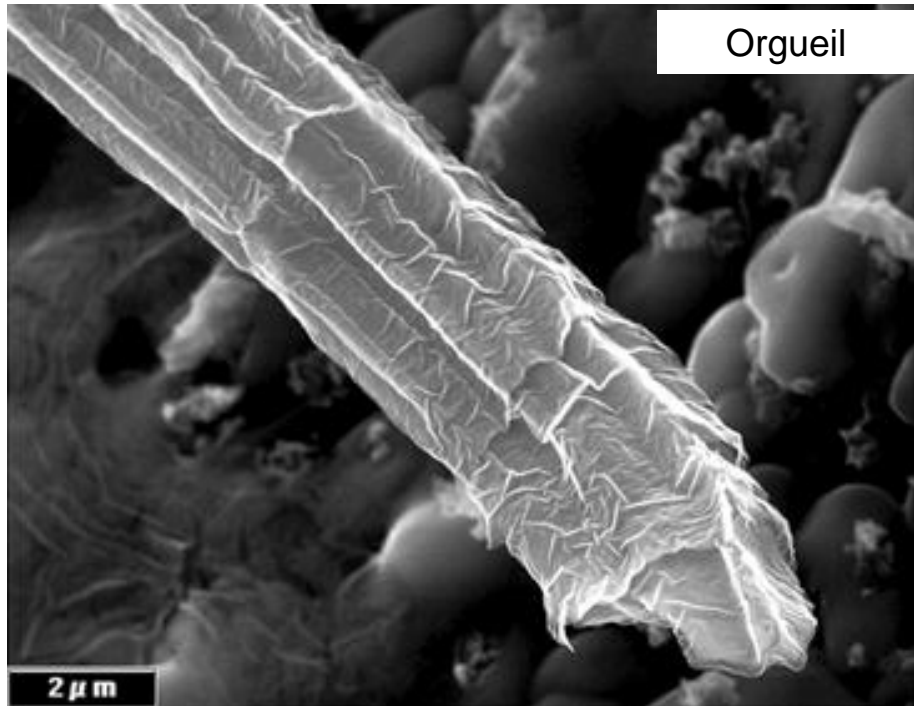
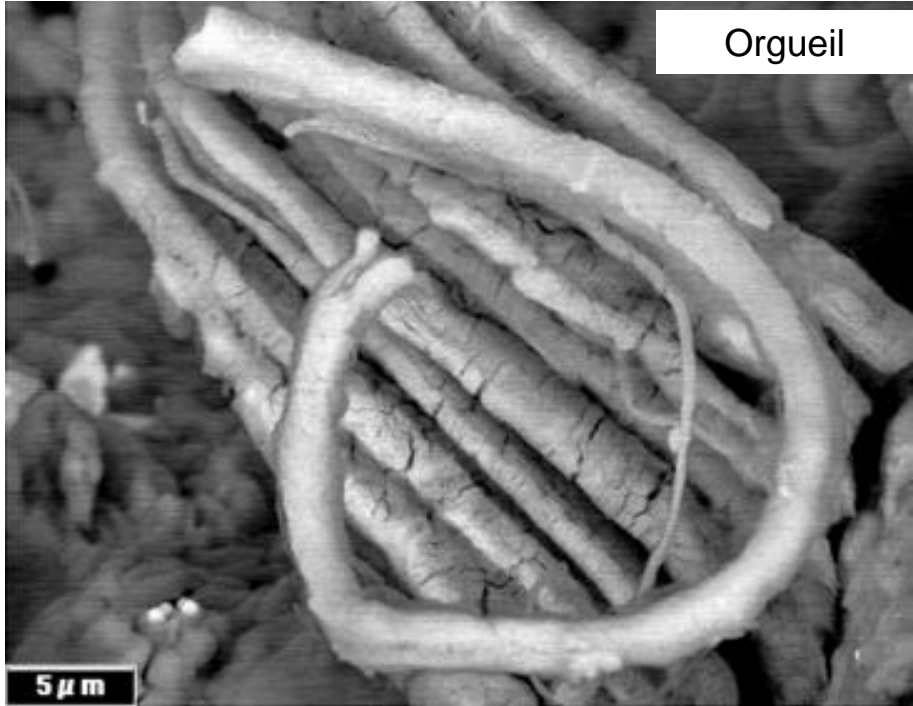


Chondrit

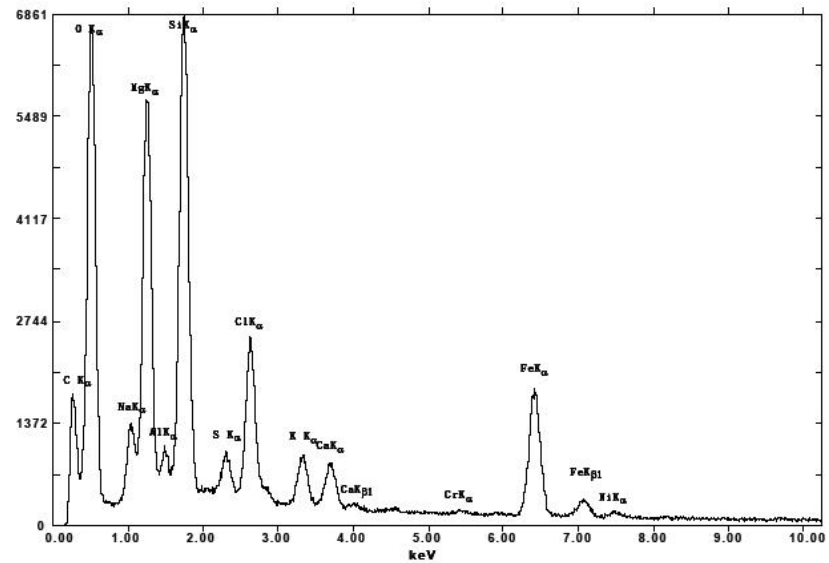
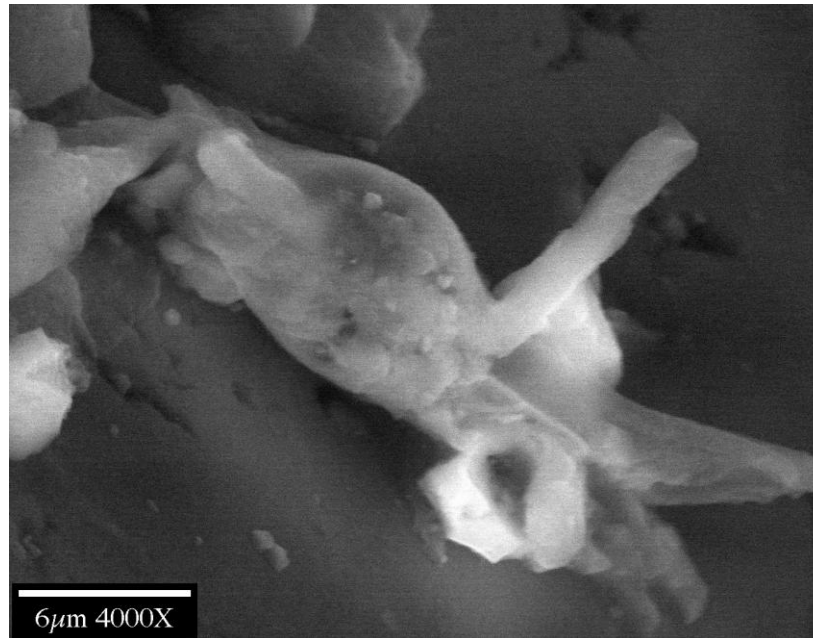
39:08

10 $\mu$ m

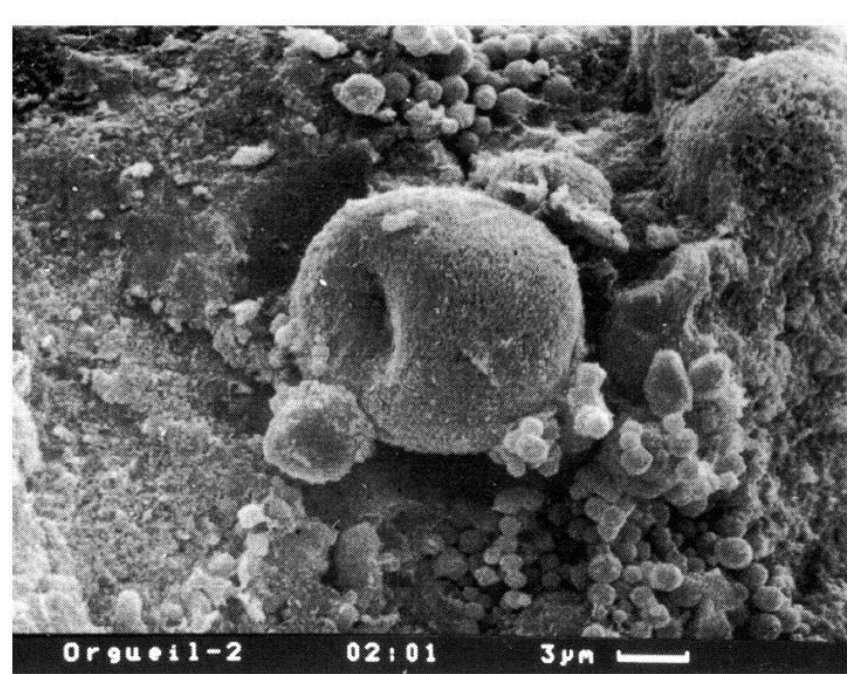
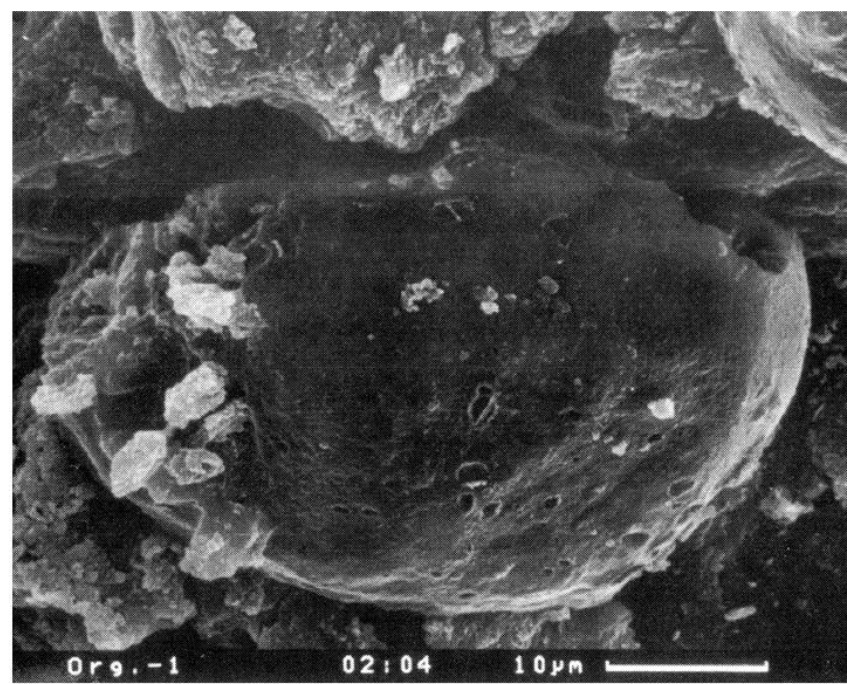
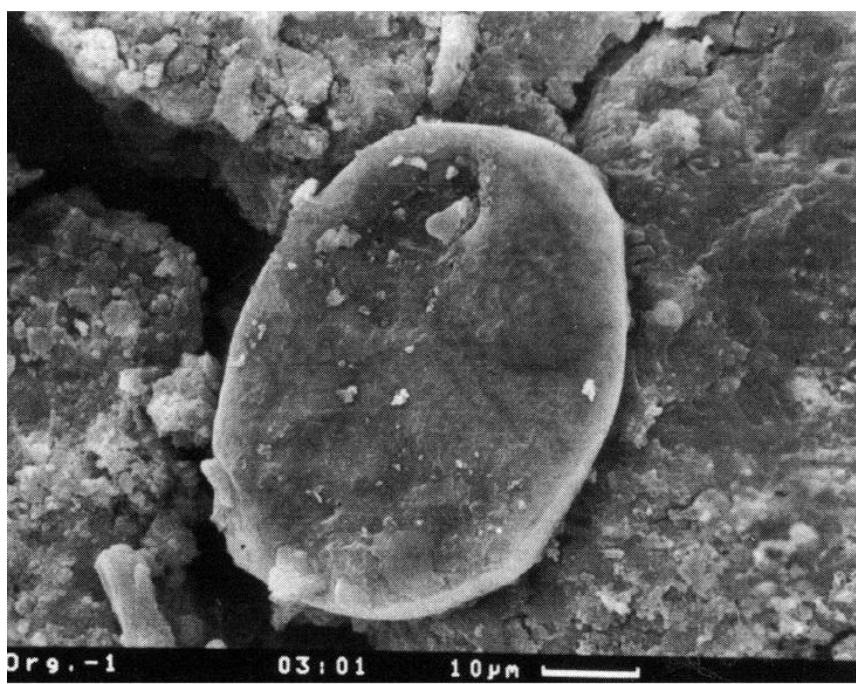




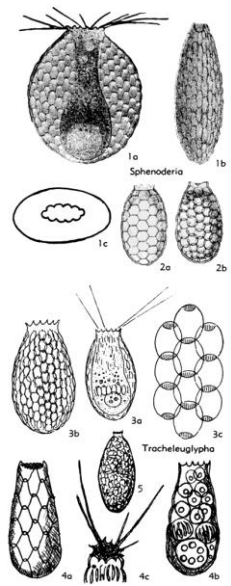
# EFREMOVKA



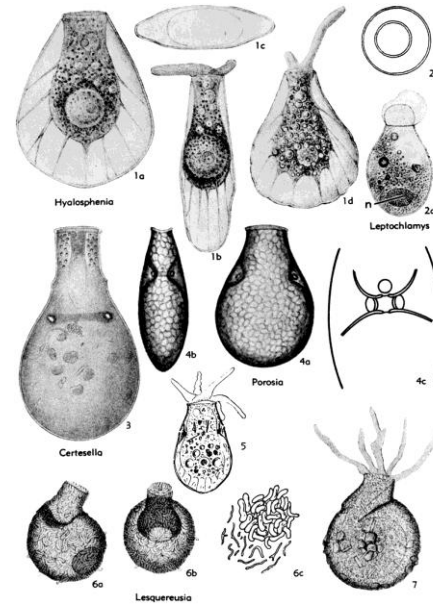
Efremovka  
ef1\_e12\_2500x.tif, bug?  
Analyst: Jerman keV: 30.00 Current: 0.50 Live Time: 93.31 eV/Channel= 10.00  
Detector Resolution: 145.00 eV Take-off angle= 40.00 Spectrum # 6 From the file: Spectrum2.Dat



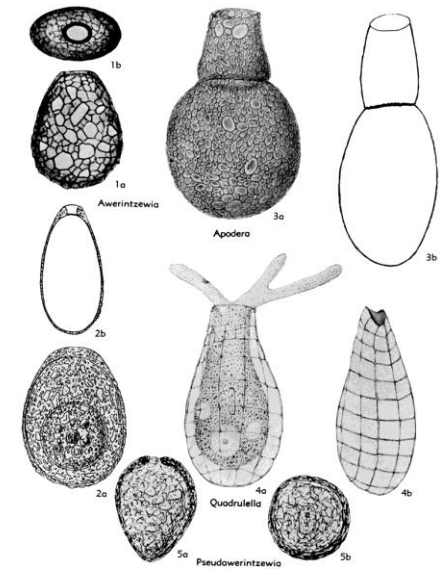
Prospective eukaryotic organisms in meteorite Orgueil



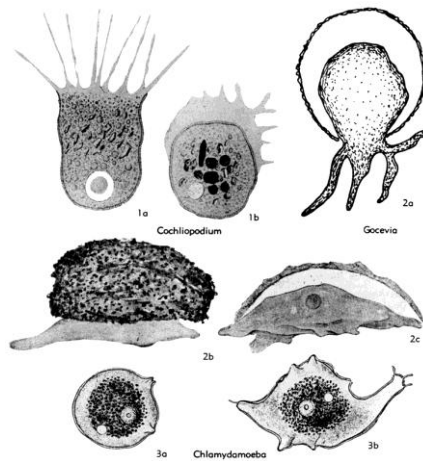
Euglyphidae (Euglyphinae);  
1, 2, *Sphenoderia*; 3-5, *Tracheleuglypha*.



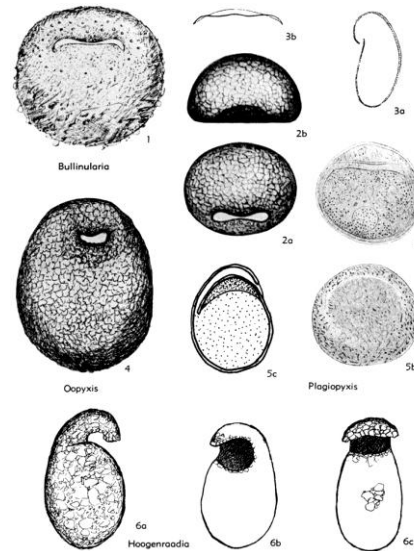
Hyalospheniidae; 1, *Hyalosphenia*; 2, *Leptochlamys*;  
3, *Certesella*; 4, 5, *Porosia*; 6, 7, *Lesquereusia*.



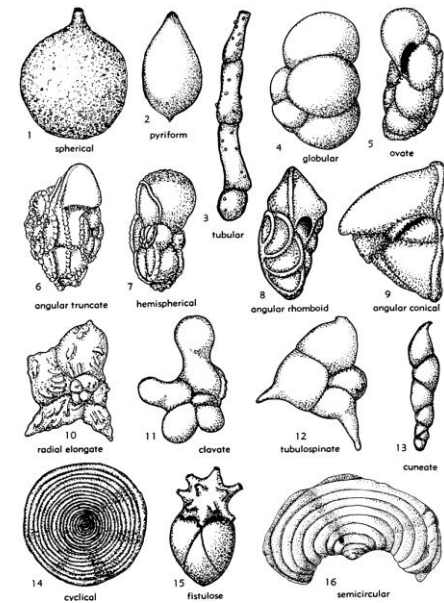
Hyalospheniidae; 1, 2, *Awerintzewia*; 3, *Apodera*;  
4, *Quadrulella*; 5, *Pseudawerintzewia*.



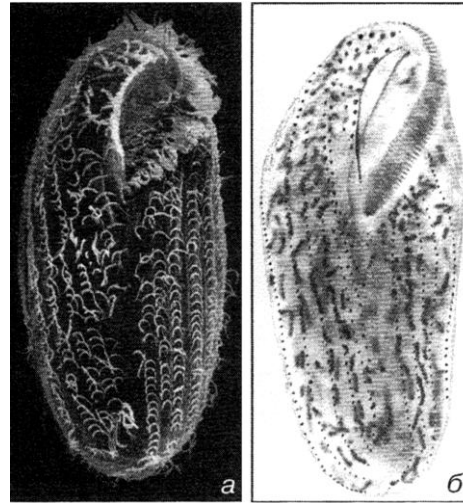
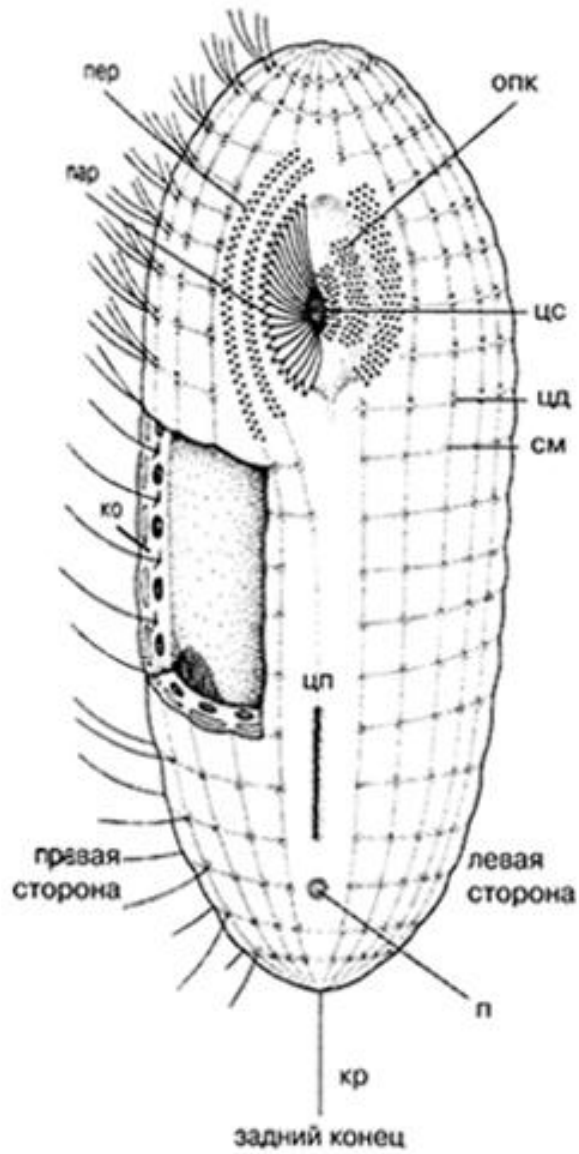
Cochliopodiidae; 1, *Cichliopodium*; 2, *Gocevia*;  
3, *Chlamydamoeba*.



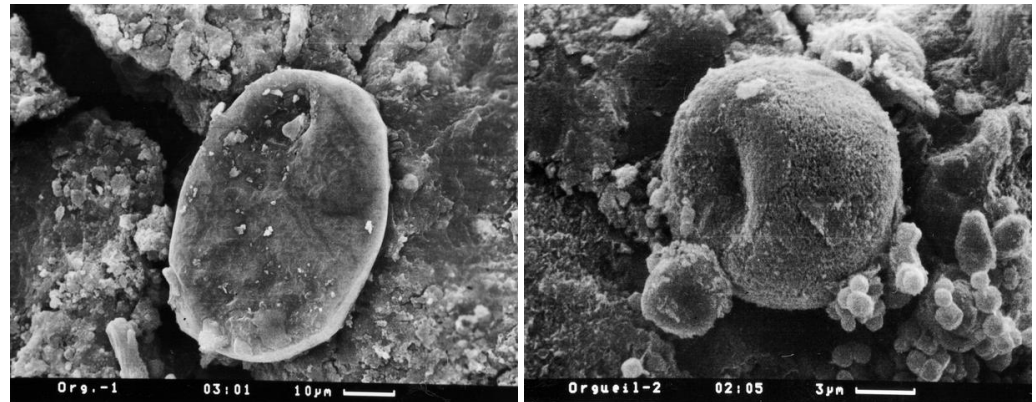
Plagiopyxidae; 1-3, *Bullinularia*; 4, *Oopyxis*;  
5, *Plagiopyxis*; 6, *Hoogenraadia*.



1-16. Shapes of chambers in foraminiferal tests.



**Spirotrichea:**  
ventral side of *Urostyla grandis*: image obtained by SEM (a) and transmitted light photo after protargol impregnation (b). x190



**Orgueil**

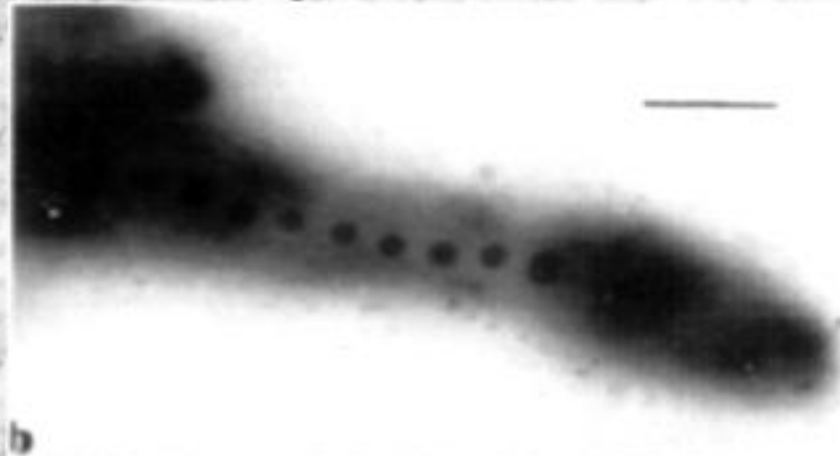
Alveolata, Ciliophora



# Evidence for Microfossils in the Orgueil meteorite



**“Electron Dense” bodies in Orgueil Filament - *Tan and Van Landingham, 1967***



**Magnetosomes in *Rhodopseudomonas rubilis* purple sulfur bacteria - *Vainshtein, 1997***

4

# Phanerozoic Detail





Aldan River, Dvortsy Section



Nokhoroy Mb

Base of Atdabanian Stage

Pestrotsvet Fm

Lena River, Zhurinsky Mys Section



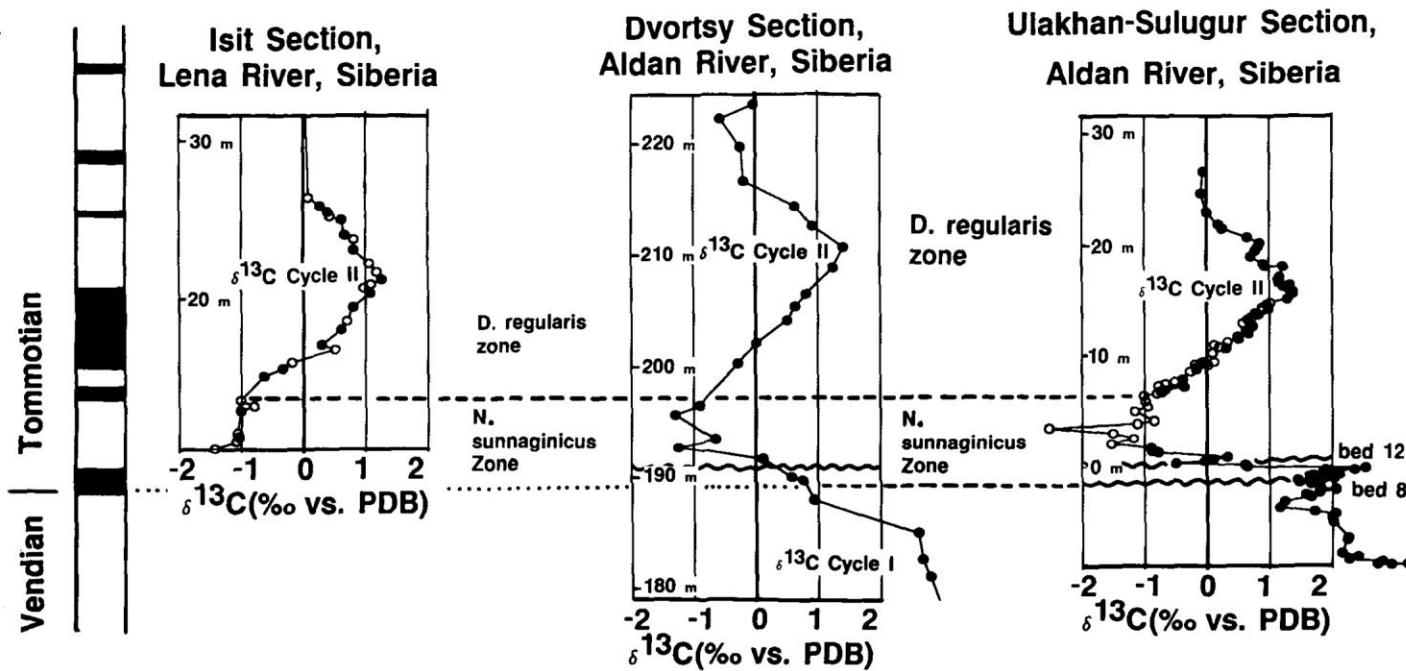
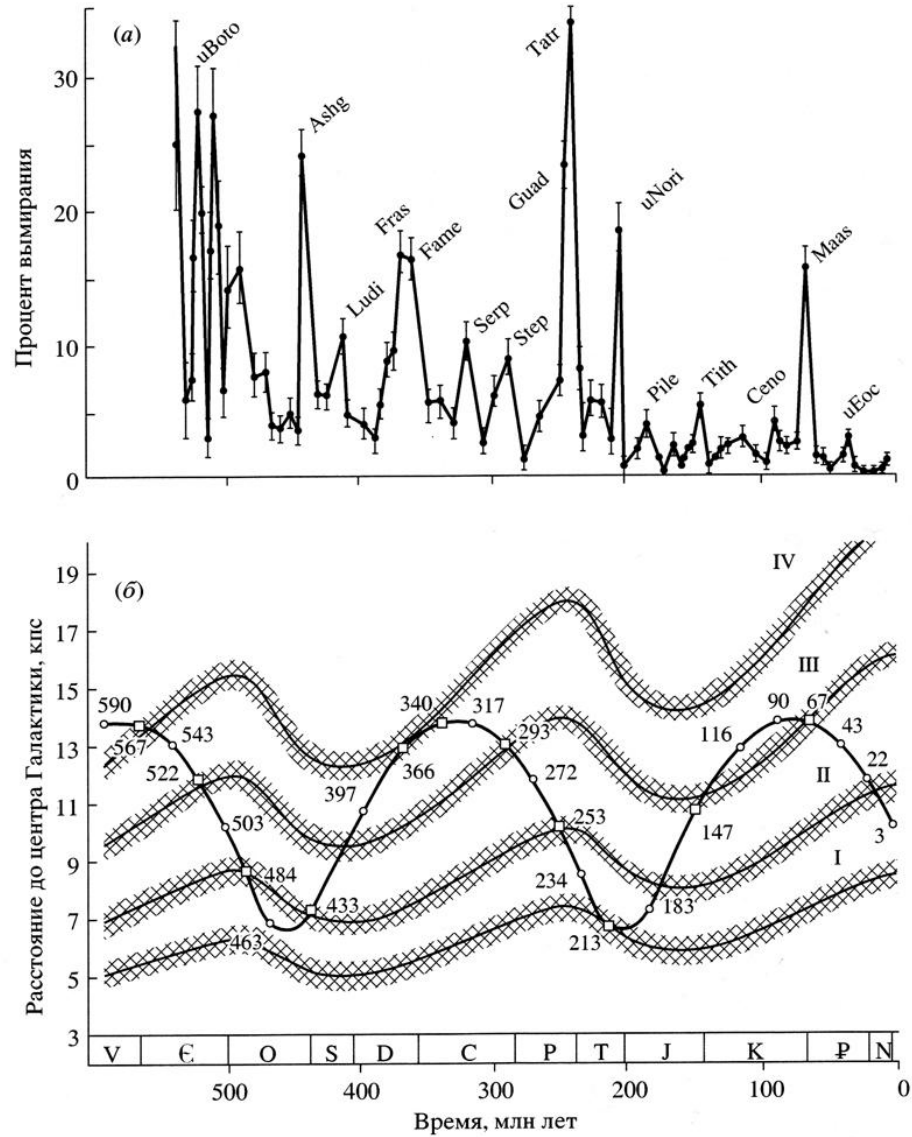


Figure 1. Carbon-isotope comparisons between three Precambrian/Cambrian boundary sections in Siberia. Dvortsy is type section for Tommotian Stage, and Ulakhan-Sulugur is candidate for International Stratotype Section for Precambrian/Cambrian boundary. Dashed lines show approximate limits for basal zone of Tommotian stage, *N. sunnaginicus*; wavy lines indicate location of known sedimentary disconformities that may indicate removal of some sequence. Data from Isit are new; those from Aldan River are compiled from Magaritz et al. (1986) and Magaritz (1989). Locality information is from Kirschvink and Rozanov (1984). Solid symbols show results from isotopic analyses of dolomite fraction; open symbols are for whole-rock analyses (PDB = Peedee belemnite). Magnetic reversal pattern (normal = black, reversed = white) has been compiled from Tommotian pattern of Kirschvink and Rozanov (1984), using polarity reinterpretation of Kirschvink (1991). Vendian/Tommotian boundary lies within short normal-polarity magnetozone recognized at both Dvortsy (in four samples) and at Ulakhan-Sulugur (in ten samples).



**Рис. 3.** Сопоставление кривой вымирания семейств морских организмов в фанерозое по подсчетам Сепкоски (а) с положением Солнца на орбите и удалением от центра Галактики четырех спиральных рукавов (б).

I–IV – номера спиральных ветвей Галактики (рис. 1). Ширина галактических ветвей условно принята равной 1 кпс. Кривая с точками – положение Солнца на орбите. Точки с цифрами – моменты попадания Солнца в струйные потоки, рассчитанные с учетом вращения солнечной орбиты. Квадратами выделены моменты времени одновременного пребывания Солнца в струйных потоках и спиральных галактических рукавах.

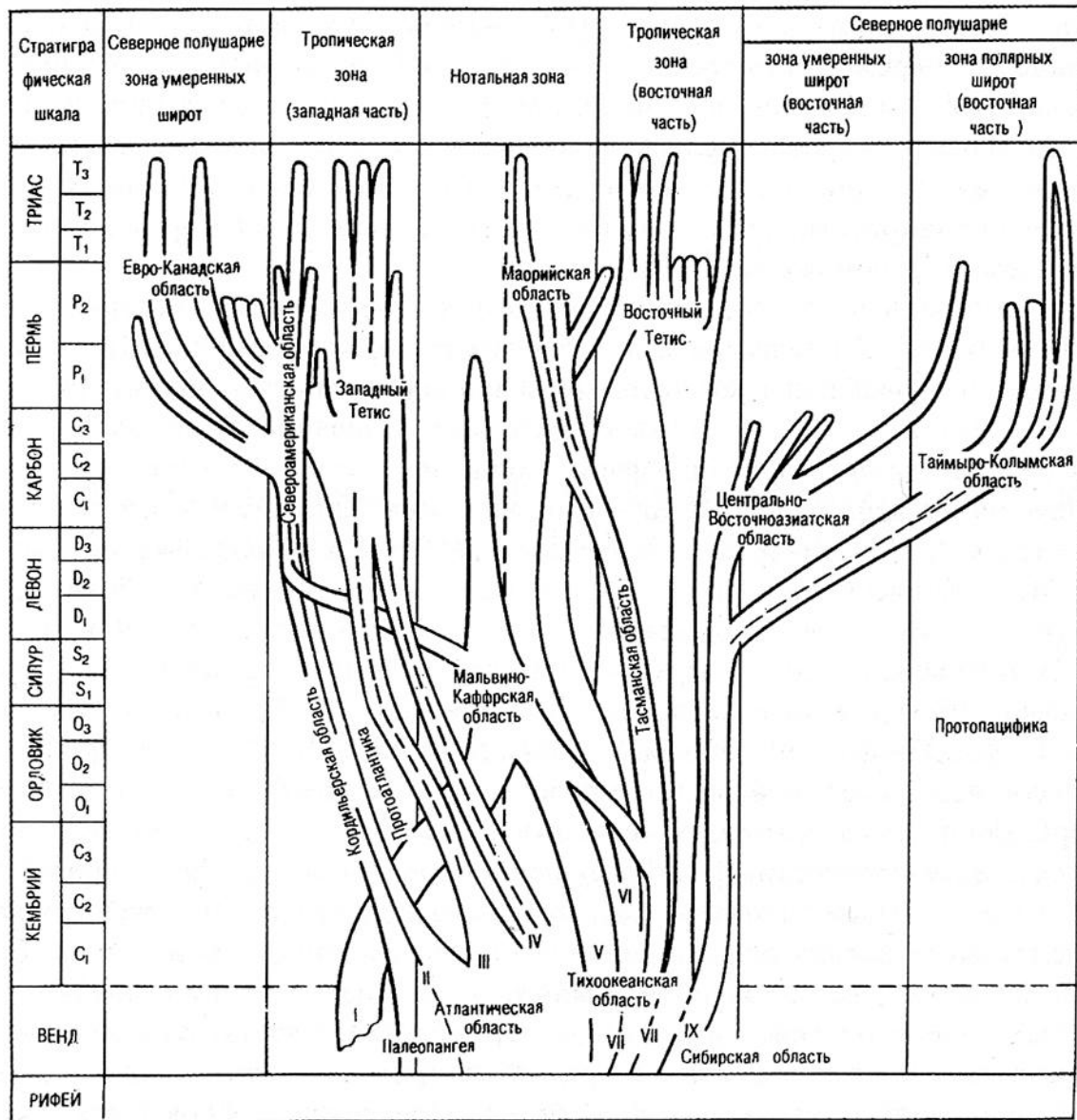


Рис. 1. Фауногенетическая схема палеозойских и триасовых морских бассейнов: I – Африка; II – Северная Америка; III – Восточно-Европейская платформа; IV – Центральная Европа, Южная Европа, Аравийская платформа; V – Южная Америка; VI – Индо-Пакистанский блок; VII – Австрало-Антарктический блок; VIII – Китайская платформа, Индо-Китайский блок, Таримская плита; IX – Сибирская платформа, Казахстан, Западная Монголия, Алтае-Саянская складчатая область.